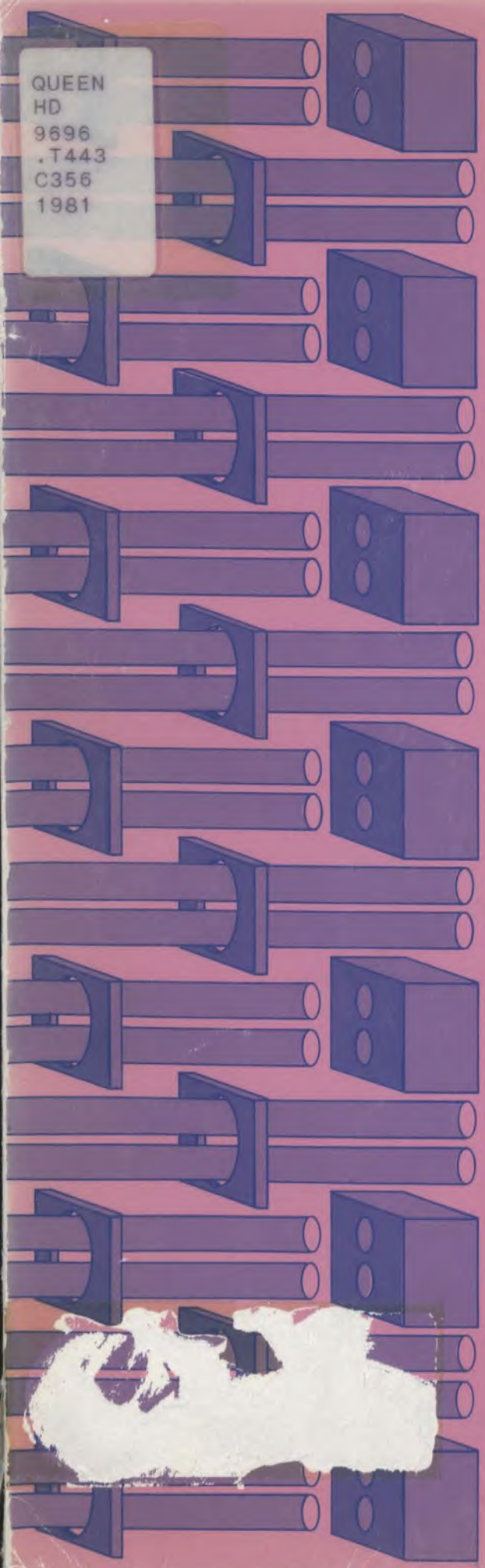
The supply of communications equipment in Canada

COMMUNICATIONS



Government of Canada
Department of Communications

Gouvernement du Canada
Ministère des Communications

THE SUPPLY OF COMMUNICATIONS EQUIPMENT IN CANADA

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Chapter 1

INTRODUCTION

During the past several years, many observers have emphasized that Canada, along with other industrialized countries, is on the verge of an information revolution. In their exploration of the features of this revolution, these observers have noted the growing importance of information-related activities in our daily work and concluded that we shall soon have an economy characterized as much by the exchange of information as transactions in goods and services. Within such an economy, the quick and efficient exchange of information will be vital to Canadian competitiveness and Canada's communications industry will play an increasingly important role. This report focuses on one sector of that industry -- the manufacturers of communications equipment.

In 1974, the Department of Communications (DOC) published a working paper entitled Canadian Telecommunications Carriers and Their Suppliers (the "Red Book"). Communications technology has evolved so rapidly since that time that much of the information in that report has been overtaken by events. For this reason, the Department published in December 1979 a volume on The Principal Canadian Telecommunications Carriers: Expenditures on Telecommunications Equipment, 1973-82. The present report is a companion to the 1979 volume and continues the process of updating the 1974 report.

What has happened since 1974? The answer lies in the intensification of two trends which, taken together, may well transform the market for

communications equipment in the next decade. Both relate to the technology used in communications.

The first trend is towards an ever more rapid rate of technological change within the communications industry. Since 1974, the pace at which products embodying new technologies supersede older products has increased. Many of these new products have had a far-reaching impact not only on communications but also on communications equipment manufacturers.

The combination of development with perhaps the most widespread implications has been the growing use of microelectronics, the arrival to maturity of software control and the application of digital signal processing. The resulting convergence of telecommunications and computer technologies is giving birth to new services that are revolutionizing the communications industry. The traditional boundaries of the telecommunications carriers' activities have become blurred. In response to this development, successive decisions by the courts and the Canadian Radio-Television and Telecommunications Commission (CRTC) have relaxed the barriers to interconnection with communications networks. These decisions have introduced a new competitiveness into the Canadian telecommunications industry and, along with the new technology, have helped to create new markets for communications equipment. However, they have also changed traditional market patterns thus making predictions of future business opportunities more difficult for established manufacturers.

The second trend involves a new and sustained drive towards technological sovereignty in the area of communications equipment. The Canadian

government and many Canadian businesses are placing more emphasis on ensuring that products embodying the new technology are developed and manufactured in Canada. Northern Telecom has led the way in the production of electronic digital switching equipment. B.C. Tel has acquired its two principal suppliers of communications equipment and merged them into a single firm complemented by a strong R & D capability. Smaller progressive Canadian companies are relying on their own variation of the new technology to make significant inroads on the market.

A more subtle force for technological sovereignty has been a growing tendency towards accommodation between public and private enterprise. For example: 1. Canada's three major provincial government-owned carriers -- Saskatchewan Telecommunications, Alberta Government Telephones and the Manitoba Telephone System -- have turned more and more to Canadian manufacturers to supply them with communications equipment for projects, both experimental and commercial, involving the new technology. 2. Canada's domestic satellite carrier, Telesat Canada, -- half-owned by the federal government and half by Canadian-owned common carriers -- has adjusted to policy changes which permit some non-carrier licensing of satellite earth stations. As a result, the market for earth stations and associated equipment produced by Canadian manufacturers has grown substantially of late and will continue to do so over the next few years if the United States experience in this regard is repeated in Canada. 3. The federal Department of Communications now operates a program to transfer to the private sector the new videotex technology developed in government laboratories at the Communications Research Centre. It has also expanded its integrated facility for the assembly and testing of complete satellite systems and leases its use to the private sector at cost.

This drive towards technological sovereignty has no doubt strengthened the competitive position of Canadian manufacturers in the domestic and international markets. Less clear, however, is the impact of the ever increasing pace of technological development in communications. Certainly, some manufacturers owe their emergence or continued survival to the new information technology, but others may have mixed feelings about these developments. Public assertions of the desirability of technological sovereignty can help in this respect. Indeed, publication of this report partly reflects the hope that the above-mentioned instances of a greater synergy between technological advance and evolving public policy can be repeated in the future.

The report is by no means comprehensive. It covers only 88 companies supplying voice and data communications equipment which fall into three basic categories: switching, transmission and terminating equipment. Companies manufacturing equipment for navigational aids, conventional radio and TV broadcasting systems, cable TV* and consumer appliances for the home are not covered nor are companies the products of which are used primarily as office equipment.

The report is intended to illustrate the impact of a variety of existing and emerging technologies on markets and the opportunities for future growth. The maintenance of Canada's hard-won excellence and technological lead in communications, as well as our ability to provide all Canadians with high quality communications services, is significantly dependent on the success of these manufacturers. Canadian success in telecommunications equipment manufacturing also has profound implications for our trade balance and on the viability of Canadian manufacturing as a whole. Indeed, the preservation of

* The cable equipment scene is evolving rapidly. Much of the cable industry's equipment purchases involves foreign products but Canadian manufacturers are increasingly interested and involved in supplying cable operators. The subject will be dealt with in a future report.

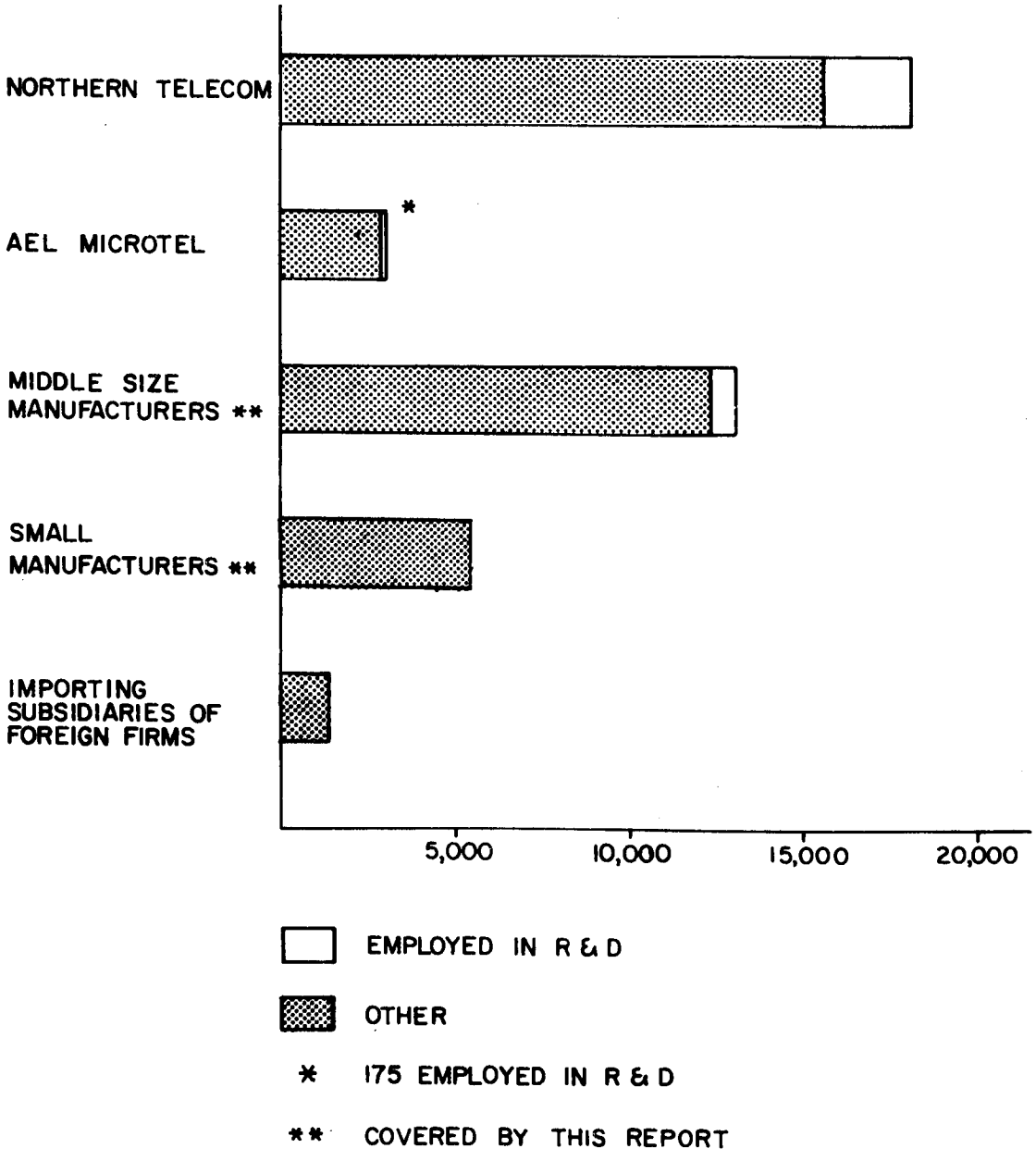
Canadian sovereignty in the communications equipment manufacturing industry could help to repatriate other economic activities particularly those relevant to the information economy of the future. A decline in the strength of domestic communications equipment manufacturing could have a serious impact on employment in Canada. The 88 firms surveyed in this report, which do not represent all the communications equipment manufacturers in Canada, employed about 40,000 Canadians in 1978. As information-related activities take on a growing economic importance, their contribution to Canadian employment will become even more significant.

The report commences with a description of the largest Canadian telecommunications equipment manufacturers and moves on to progressively smaller Canadian firms and to the foreign-based companies operating in this country. It concludes with an overview of large multinationals operating on the world market.

Thus, Chapter 2 deals with Northern Telecom and Chapter 3 with the newly formed AEL Microtel. These companies have close links with carriers and are the two largest communications equipment manufacturers. They are the only two Canadian companies capable of supplying a broad range of network equipment including integrated large-scale central office and transmission systems. They are also the only Canadian firms capable of sustaining an intensive R and D effort in a broad range of product areas. Both derived revenues in excess of $100 million a year in 1978 and, as Figure 1-1 shows, employed in that year about 21,000 (Northern: 18,000; AEL Microtel; 3,000) of the 40,000 Canadians working for the communications equipment manufacturers covered by this report.

FIGURE 1-1

CANADIAN RESIDENTS EMPLOYED BY MANUFACTURERS / SUPPLIERS OF COMMUNICATIONS EQUIPMENT IN 1978



Chapter 4 focuses on 14 manufacturers with annual sales between $10 million and $100 million. These companies lack corporate ties to any of the carriers and employ about 13,000 Canadians. If ordered chronologically by date of establishment, the products which they manufacture present a history of technological development in communications within Canada. The oldest companies make wire and cable products while the next oldest manufacture mobile radio systems*. Then follow newer companies making microwave radio systems and satellite communications systems and components. Finally are encountered recently established companies taking advantage of the convergence between computer and telecommunications technologies to produce electronic and digital terminal and switching equipment. Customers for these product lines include, not only the common carriers, but also military agencies, public utilities, foreign governments, the Canadian construction industry and business generally. Many of the companies focus their research and development on selected products. They have such diverse interests that their high technology products complement rather than compete with those of other communications equipment manufacturers. The companies are either Canadian-owned or operate as Canadian-owned manufacturers in that most of their domestic sales relate to products manufactured in this country.

Chapter 5 summarizes the results of a survey of 64 smaller manufacturers with annual sales of less than $10 million. These firms perform an important service by providing components and small assemblies to the larger manufacturers. As a group, they employ more than 5,400 Canadians.

* This is not to imply that wire and cable and radio have not moved with the times. The related products have, of course, evolved with new generations of equipment replacing those left behind by technological advance.

Chapter 6 briefly describes eight foreign-owned subsidiaries in Canada. Figure 1.1 shows that these companies together employ about 1,400 Canadians the majority of whom are involved in the supply of communications-related products and services. These companies differ from the subsidiaries of foreign firms described in Chapter 4 in that they import fully or partially assembled products to Canada -- products manufactured, for the most part, in the home country of the parent. As they currently experience a declining market base in this country and increasing non-tariff barriers elsewhere, they are exhibiting a perceptible tendency to establish some Canadian R and D and manufacturing facilities to bolster their position in the domestic market. This is especially true for European subsidiaries which hope to manufacture product lines more suited to North American demand.

Chapter 7 provides an overview of the principal multinational communications equipment manufacturers, their share of the world market and the thrust of their R and D expenditures.

Chapter 8 deals with some of the factors contributing to Canada's success in the international communications equipment market and with the problems that remain to be overcome in that area. The manner in which these issues are dealt with will have significant implications for the future of communications equipment manufacturing in this country.

Chapter 2

NORTHERN TELECOM

Northern Telecom Limited (NTL), majority owned by Bell Canada, is the largest Canadian company engaged in the research, manufacture and sale of communications equipment and electronic office systems. The company is a Canadian-based multinational, which employed about 32,000 people world-wide and operated 52 manufacturing plants in Canada, the United States, England, Eire, Turkey, Malaysia and Brazil in 1978 (current employment is in excess of 33,000 and the number of plants in operation has risen to 55). It is the only Canadian manufacturer offering a complete range of equipment in switching, transmission, outside plant and subscriber apparatus.

By its own estimate, NTL supplies about 70 per cent of the Canadian market for telecommunications equipment. During the 1970s, the company had an unbroken record of financial success despite a moderation in the North American economy in which its activities are concentrated. Between 1972 and 1978, its consolidated sales tripled to $1.5 billion while its net earnings rose to $100 million -- five times their 1972 level (Table 2-1)*.

* Sales were expected to break the $2 billion mark in 1980 but earnings were under severe strain as the full impact of corporate reorganizations in the United States and of start-up costs for the manufacture and distribution of the new line of digital switching equipment (DMS) were being felt.

Table 2-1

Ten year consolidated sales and earnings

	78	77	76	75	74	73	72	71	70	69
(1) consolidated sales ($ million)	1505	1222	1083	997	958	608	531	574	562	482
(2) percentage increase over previous year	23.1	12.8	8.6	4.1	57.6	14.5	-7.5	2.1	16.6	
Net earnings after tax ($ million)	101	85	77	67	54	32	20	13	4	11
Net earnings as a percent of sales	6.7	7.0	7.1	6.8	5.6	5.3	3.8	2.2	0.7	2.3
Net earnings per share (dollars)	3.55	3.22	2.91	2.55	2.05	1.35	0.85	0.54	0.17	0.52

(1) Excludes NETAS (NTL's Turkish subsidiary) and finance subsidiaries. Manufacturing sales were 88 per cent of total sales in 1978. With the disposal of the Nedco and Zentronics distribution business in 1979, virtually all sales will be of manufactured products.

(2) The 23 per cent sales increase in 1978 was due to the acquisition of four U.S. companies. Canadian sales were about the same as in the previous year.

THE GLOBAL REACH

Bell Canada has held a majority interest in Northern Telecom since 1956 when it purchased it from the U.S. multinational, Western Electric. Bell is the largest telecommunication carrier in Canada, with operating revenues of $2.5 billion and 9 million telephones in service (60 per cent of the national total). As of December 1, 1979, Bell owned 55 per cent of Northern's common stock.

Bell and its affiliated carriers are the largest Northern customers, accounting for 34 per cent of Northern's 1979 world wide sales. Clearly, the close relationship between Bell and Northern has been a major factor in NTL's success. However, sales to Bell constitute a declining proportion of Northern's worldwide sales (they fell from 54 to 34 per cent of the total between 1975 and 1979). NTL's major growth in recent years has been in foreign sales. (Table 2-2).

Despite the reduced dependence on Bell in terms of sales, the assured Bell market continues to be an important factor in NTL's marketing strategy. A large dependable domestic customer is crucial to the success of any full line communications equipment manufacturer attempting to sell complete state-of-the-art-systems in world markets. It is imperative to support the necessary R&D expenditure for certain equipment. It is also needed to provide a domestic base for trying and testing new equipment before it can be purchased with confidence by foreign customers. Bell fulfills this function for Northern and the assured cash flow is a vital precondition to successful operations in high risk international competition.

Table 2-2

Two year comparison of sales and earnings by geographic area

	Canada		U.S		Other		Total	
	78	77	78	77	78	77	78	77
Sales ($ million)	1008	1014	447	193	50	14	1505	1222
Per cent of total	67	83	30	16	3	1	100	100
(1) Net Income ($ million)	223	227	87	29	7	3	318	261
Operating margin (per cent of sales)	22	22	19	15	15	21	21	21
R and D expense ($ million)							(98)	(68)
General corporate expense ($ million)							(74)	
Operating earnings per financial statements ($ million)							146	121
Operating margin (percent of sales)							10	10

(1) Operating earnings for each geographic area, as stated by NTL, exclude R and D and general corporate expenses. A reconciliation with the consolidated operating earnings, as shown in the financial statements, is given in the lower right corner of the table.

Northern Telecom Limited (NTL) is the parent company for the Northern Telecom family. It is headquartered in Montreal and has five major subsidiaries. Table 2-3 provides a summary of these holdings while Appendix I details NTL's manufacturing operations.

NTL's wholly owned manufacturing subsidiary in Canada is Northern Telecom Canada Ltd. With head offices in Toronto, it operates 28 plants in nine provinces and employs some 15,000 people. In January 1979, Northern Telecom Canada Ltd. completed arrangements for the sale of its Nedco and Zentronics subsidiaries to Westburne International Industries Ltd. of Calgary. From 46 Canadian locations, Nedco and Zentronics distribute wire, cable and electrical equipment for industrial and construction applications. Their product lines included both Northern products, and those of other manufacturers. Westburne will continue to offer the Northern Telecom products which, in 1978, accounted for 20 per cent of Nedco's sales.

NTL's Canadian research arm, Bell Northern Research Ltd. (BNR) is by far the largest industrial R and D establishment in Canada. 70 per cent owned by NTL and 30 per cent by Bell Canada, it is headquartered in Ottawa and employs some 2,800 people. The sizeable investment that it represents reflects NTL's recognition of the importance of industrial R & D to the company's continued growth. BNR is also the parent of BNR Inc., the NTL research organization in the United States.

NTL possesses extensive holdings outside North and South America through its wholly owned subsidiary, Northern Telecom International Ltd. (NTIL). NTIL is headquartered in Montreal, employs 550 persons and operates marketing organizations in England, Switzerland, France, West Germany, Hong Kong and Singapore. The company also controls and runs manufacturing plants in Malaysia, Eire and Turkey. Sales, in markets outside Canada and the United States, accounted for about three per cent of NTL's total sales in 1978.

NTL's extensive holdings in the United States have grown dramatically in the last few years as a result of an aggressive acquisition program which in 1978 involved nearly $300 million.

Through Northern Telecom Inc. (NTI) located in Nashville, Tennessee, NTL operates 21 manufacturing plants in twelve American states, as well as one each in England, Brazil and Canada, and employs 12,000 people. In 1978, NTI purchased the former Danray Inc., a U.S. manufacturer of computer controlled solid state switching systems for the telephone interconnect business. The firm was subsequently merged into NTI. In the same year, NTI also purchased Eastern Data Industries Inc. together with its principal subsidiary, Spectron Inc., which manufactures a line of test and control equipment for data tranmission.

In addition, NTL acquired in 1978 two U.S. manufacturers of computer terminals for distributed data processing. The firms, Data 100 and Sycor Inc.,

Table 2-3

Northern Telecom and its major subsidiaries

(January 1981)

Name	Ownership	Remarks
Northern Telecom Limited (NTL)	55% Bell 45% General Public	Headquarters in Montreal Parent company for the NTL family
Northern Telecom Canada Ltd.	100% NTL	Headquarters in Toronto 15,000 employees 28 plants in nine provinces
Bell Northern Research Ltd. (BNR)	70% NTL 30% Bell	Headquarters in Ottawa 2,800 employees Five Canadian laboratories; one U.S. laboratory
Northern Telecom International Ltd.	100% NTL	Headquarters in Montreal 550 employees Plants in Turkey, Malaysia, Eire Marketing organizations in England, Switzerland, France, West Germany, Hong Kong and Singapore
Northern Telecom Inc.	100% NTI	Headquarters in Nashville 11,000 employees 21 plants in twelve states; one plant each in Brazil, England and Canada
BNR Inc. (BNRI)	100% BNR	Headquarters in Palo Alto, Claifornia About 500 employees including 250 in Ann Arbor, Michigan Research arm of NTL in USA

Note: NTL also has more then 3,000 employees in the rest of the world including about 1,800 in Turkey.

constitute the electronics office systems division of NTI.* The division is headquartered in Minneapolis, Min.

The U.S. acquisitions and increased U.S. sales were the major factors in the 23 per cent rise in the Northern family's consolidated sales between 1977 and 1978 (Table 2-1). As Table 2-2 demonstrates, U.S. sales almost doubled as a proportion of total sales between these two years. Mainly as a result of the U.S. acquisitions, the total payroll of NTL and its subsidiaries increased to 32,000 in 1978, after several years of hovering around 25,000. In the Canadian operations, however, the work force declined principally because the Canadian market for Northern products did not increase and also because the company moved to electronic solid state technology, which is far less labour intensive than electromechanical technology. Thus in 1978, Northern Telecom Canada Ltd. was producing twice the volume it did a few years before but was using 6,000 fewer employees.

The use of integrated circuits not only reduces the labour content in a device of given electrical function but can also transfer the associated labour to an outside semiconductor supplier. The resulting employment decline for the communications equipment manufacturer is a worldwide phenomenon. It is possible, however, to misunderstand this disemployment effect. The remaining employees, though fewer in number, include a far greater proportion of highly

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* The division was, until January 1981, a separate NTL subsidiary which operated under the name of Northern Telecom Systems Corporation (NTSC). NTSC has now been merged into NTI.

trained "knowledge" workers with the result that average productivity per worker is increased to the point that value added in the industry is actually greater than it was before the change in skills took place.

NEW TECHNOLOGY: THE RISK AND THE BENEFIT

Because a carrier's plant -- its switching, terminal and transmission equipment -- has, once installed, a relatively long life and because its ability to acquire equipment is in part a function of the tariff regulation under which it operates, its decisions to replace older equipment must be made after careful consideration of all costs and benefits involved. In a reasonably matured telecommunications market, demand for carrier equipment grows in step with population (and changes in its dispersion) and in response to effectiveness and efficiency considerations. Still the pace of carrier acceptance of new products is controlled: technological changes are absorbed within a planned capital improvement environment.

Northern has responded to the challenge of the situation in three ways. First, it has withdrawn from specific activities -- such as the production and distribution in Canada of power wire and cable and other electrical equipment -- which are outside its main area of specialization. Second, it has heavily committed itself to high risk R and D as a means of developing highly automated attractive new products -- and third, it has aggressively expanded into foreign markets, mainly through acquisitions in the United States.

The purchase of Sycor and Data 100 in the United States reflected the second and third approaches. Both firms manufactured electronic office systems, a product of the recent convergence between computer and communications technologies and both had R & D facilities. In buying them, Northern staked out a strong position in a new technological field and enlarged its already significant presence in the American market. In 1978, sales of electronic office systems accounted for 11 per cent of Northern's total sales, (Table 2-4) and the company's operating margin in this area represented 18 per cent of sales and was higher than for any other product category.

By far, however, the main example of Northern's involvement in research and development and the exploitation of new technologies is to be found in its initiatives in digital electronic switching. More about this is said in the following part of this chapter.

The move to electronic technology as well as the growing automation of production processes has had a profound impact on the composition of the Northern work force; it created a new demand for so-called knowledge workers -- skilled professionals in the design, manufacture, installation and servicing of the new products and their related marketing and management counterparts. Their proportion to the total work force rose from 19 to 25 per cent between 1972 and 1978. In its 1978 annual report, the company commented: "As our acquisitions in the data distribution and electronic office equipment are merged into the corporate mix, the percentage of knowledge workers will increase even more". The company predicted on the basis of present trends that the figure would be 35 percent in five years.

Table 2-4

Two year comparison of sales and earnings by business segment

	Telecommunications equipment		Electronic office systems		Distributed products		Other (2)		Total	
	78	77	78	77	78	77	78	77	78	77
Sales ($ million)	1131	1017	171	-	163	174	39	31	1505	1222
Per cent of total	75	83	11	-	11	14	3	3	100	100
(1) Operating earnings ($ million)	181	185	30	-	9	8	-	-	220	193
Operating margin (percent of sales)	16	18	18	-	5	5	-	-	15	16
General corporate expense ($ million)									(74)	(71)
Operating earnings per financial statements ($ million)									146	121
Operating margin (percent of sales)									10	10

(1) Operating earnings for each business segment, as stated by NTL, exclude the general corporate expense. A reconciliation with the consolidated operating earnings, as shown in the financial statements, is given in the lower right corner of the table.

(2) 'Other' consists principally of BNR sales to customers other than Northern. BNR is a non-profit organization.

Digital switching systems -- The calculated risk

No manufacturer can claim a major role in telecommunications without a comprehensive line of central office switching equipment. Each new generation of switching equipment arrives in a shorter interval and can serve more customers at a lesser per capita cost than its predecessors. As a result, ever larger markets are necessary to make the product a viable economic proposition.

Continued sales of central switching equipment are especially vital to the future of Northern Telecom, as they represent between 30 and 35 per cent of the company's total sales. Sales of central office switching equipment amounted to $413 million in 1977 (Table 2-5). The comparable figure for 1978 was $339 million -- a significant drop and the first in five years for this category. The reason for decline was the 1976 announcement by Northern of a new generation of central office switching equipment -- the digital multiplexing system (DMS). This announcement caused a reduction of orders for the previous generation of switching equipment, the SP-1 electronic analog switch, and there was a significant pause before its digital replacement could be brought on stream.

Northern had introduced the SP-1 analog switch in 1971, after an R and D expenditure of $90 million. During the next six years, the SP-1 generated sales of $900 million and ultimately defrayed its R and D costs. This figure would have been impossible to reach on the domestic market; the company was compelled to penetrate the American and other foreign markets.

Table 2-5

Five Year Sales and Earnings by Product Line

($ million)

	1978	1977	1976	1975	1974
Sales (1)					
Central office switching	339	413	402	372	302
Subscriber apparatus and business communications systems	374	275	214	171	180
Wire, cable and outside plant	277	215	146	127	157
Transmission	141	114	125	136	103
Discontinued lines	-	-	-	5	24
Total telecommunications equipment	1131	1018	886	810	766
Electronic office systems	172	-	-	-	-
Distributed products (2)	163	174	185	186	192
Other, principally R and D (3)	39	31	13	-	-
Total	1505	1222	1083	997	958
Operating Earnings (1)					
Telecommunications equipment	181	185	168	155	127
Electronic office systems	30	-	-	-	-
Distributed products (2)	9	8	9	15	17
Total	220	193	177	170	144

(1) Sales and operating earnings have been restated by NTL for 1977 and prior years to conform with the presentation adopted in 1978. Operating earnings exclude general corporate expense.

(2) Business discontinued effective December 31, 1978

(3)"Other" includes sales of BNR from August 3, 1976.

Why did Northern announce its new generation of digital switches when it knew this announcement would affect sales of the SP-1 and when the company was not ready to produce large quantities of the new digital switching equipment? In making the announcement, management took a calculated risk based on a carefully considered prediction that central switching offices would move towards digital technology at a faster rate than expected by other manufacturers. The stakes were considerable. The estimated R and D expenditures for the new product line will amount to $270 million by 1983, roughly three times the R and D expenditures on the SP-1. As a result, Northern's greater penetration of all accessible foreign markets was imperative.

The first model of the DMS went into service in 1977. Production of the new equipment expanded significantly in 1979. Table 2-6 provides an indication of its reception in the market place. By March 31, 1979, Northern Telecom had put in service or had reserve orders or firm commitments for some 800 DMS systems. Bell Canada and Teleglobe Canada were the first carriers to place the larger machines in service -- a DMS-100 and a DMS-200 in the case of Bell and a DMS-300 in the case of Teleglobe. By March 31, 1980, the number of DMS systems in service or on order had reached 1,506. These included 965 DMS-1, 397 DMS-10 and 144 of the larger DMS switches.

The DMS line is meeting with success in foreign markets. Caribbean nations have purchased 10 systems, including one DMS-100. In December 1979, Northern announced it had won a contract to supply digital transmission equipment to South Korea; the contract, still under negotiation, is expected to

Table 2-6

DMS switches in service and on order

Type of switch		Initial service date	Systems in service/ on order March 31, 79	Systems in service/ on order March 31,1980
DMS-1	256 line subscriber carrier and remote switch	1977	239/311	589/376
DMS-10	12,000 line local switch	1977	48/152	192/205
DMS-100	100,000 line local switch	1979		
DMS-200	60,000 trunk toll switch	1979		
DMS-100/200	local-toll system		1/49	10/134
DMS-300	27,000 trunk international gateway	1979		
			288/512	791/715
Total number of systems			800	1506

be worth about $90 million. Eighty per cent of the DMS-10 orders have originated in the United States. For example, Northern has DMS-10 contracts of $100 million with AT&T and $50 million each with Continental Telephone Corporation and Central Telephone and Utilities.

Within a year of the Northern announcement, one Japanese and three American manufacturers had announced digital switches for a class 5 local office. Other suppliers have quickly followed suit.

Semiconductor manufacture - A lesson learned

Semiconductors and their associated software are at the heart of modern communications. In the early 1960s, they were already being used by manufacturers of telecommunications equipment who usually purchased them from American firms specializing in this area. The technology evolved rapidly. In the latter 1960s, it had moved into integrated circuits -- combinations of discrete miniaturized devices on a single silicon chip capable of producing a complete circuit function. These circuits became smaller and complex as a result of techniques such as large scale integration (LSI) and very large scale integration (VLSI), and developed into increasingly important components of a wide range of communications products.

Northern became involved in the manufacture of semiconductors in the 1960s, as a result of its licensing agreements with its former parent Western Electric. At that time, the Western designs, manufactured by Northern, employed

a number of proprietary diodes, transistors and other discrete devices that could only be obtained by in-house manufacture or importation. In an effort to reduce its reliance on Western, and on U.S. imports in general, Northern undertook the manufacture of these devices on an increasing scale in its R and D division located in Ottawa, later to become Bell-Northern Research (BNR). At about the same time, Northern adopted a policy to replace the Western Electric design of equipment, in which the semiconductors were used, with products of its own design, notably the SP-1 electronic switching system. Realizing that its dependence on semiconductors would increase with each new generation of equipment, Northern decided in 1969, with the encouragement and support of the federal Department of Industry, Trade and Commerce, to form a separate R and D and manufacturing subsidiary, Microsystems International Limited (MIL).

MIL was an ambitious project, intended to supply general-purpose and custom circuit devices for the general trade, as well as proprietary circuit devices for Northern's internal use. It established its headquarters in Ottawa and a manufacturing plant in Malaysia but was unable to establish a foothold in the market. Sales rose to a peak of $24 million in 1974, but the company was shut down in 1975 having suffered an aggregate loss of $50 million from the time of its inception.

During this period, BNR had continued the development and pilot production of the custom circuit devices required by Northern Telecom. With the demise of MIL, BNR expanded its activities in this area spending more than $30

million on this and related accounts between 1973 and 1978. As more and more integrated circuit devices were needed and had to be purchased abroad, because no Canadian supply was available, Northern acquired a 24 per cent interest in the U.S. semiconductor firm, Intersil, and thus kept a window on the manufacturing side of the scene.

The advent of the DMS line caused a quantum jump in Northern's semiconductor requirements because digital transmission and switching require extensive use of semiconductor technology. It induced Northern in 1979 to resume production of custom LSI circuits in Ottawa and California, with R and D performed in Canada. The Ottawa plant is to employ some 250 people and to produce some $20 million worth of semiconductors a year.

In retrospect, the MIL experience may have been of some value. Once it was established that the then prevailing (1970) domestic base for semiconductors was indequate to sustain profitable operations, the company's role was changed to that of alternate source of standard components. The strategy did not succeed and MIL ultimately went under. NTL's return to the production of semiconductors is predicated on MlL's original business plan which could not be followed because of the market circumstances of the time: exploitation of domestic opportunities for specialized (custom) LSI followed by the penetration of foreign markets with similar products. NTL is confident that this time the formula will succeed.

Opto-electronics -- The leading edge

One of the latest developments in telecommunications technology is the use of a single glass fibre, as thin as a human hair, to carry 10,000 telephone conversations or their equivalent in video or data transmission. The technique transforms an electrical signal into a modulated light beam and transmits it through the fibre -- with the assistance of amplifiers spaced along the route as necessary -- and reconstitutes the electrical signal at the far end. The term, "opto-electronics", is used to describe the process.

Optical fibres have two major advantages over conventional copper cable: their much smaller size and their immunity to electromagnetic interference. Both are important considerations in urban environments where conduits are crowded and electrical noise is high.

Northern Telecom's involvement in opto-electronics began in 1972 through its affiliate, Bell-Northern Research (BNR). By 1974, BNR had designed a weapons fire control system using fibre optics for the Iroquois class destroyer. In 1976, BNR installed at National Defence Headquarters in Ottawa an optical communications system for ultra-secure services in voice, two way closed circuit TV and high speed data.

A year later, Northern Telecom formed an optical systems division to establish a pilot manufacturing facility for glass fibre and cable and ancillary equipment. Originally part of the Lachine cable plant and employing technology transferred from BNR, the division was subsequently located in 8,000 square feet of floorspace in Kanata, Ontario. In 1977 and 1978, the division supplied the

fibre for two Bell field trials testing inter-office optical communications trunk in Montreal and a local opto-electronics distribution plant in Toronto.

The Kanata facility was, until recently, viewed as adequate to meet the demand for glass fibre expected in the next two or three years. Initially this was to arise mainly from field trials, such as the one sponsored in Elie, Manitoba, by the Federal Department of Communications and the Canadian Telecommunications Carriers Association to test the utility of opto-electronics in the provision of rural communications services.

However, the demand rose faster than anticipated as plans for field trials and fibre optics systems multiplied. Northern won, in 1979, a $22 million contract from Saskatchewan Telecommunications, the provincially owned telephone company, to supply fibre optics cable and other equipment for a $56 million, fibre optic broadband network linking major communities in the province. The new system will carry voice, video and data traffic and will have a top capacity of 12 video channels or their equivalent. The cable will extend for 3,200 kilometres and enclose 38 million metres of optical fibre -- more than has been produced in the world up to the present time. Installation will be complete by 1984.

As a result of this development and others, Northern Telecom Canada Limited announced in March 1980 its decision to build in Saskatoon, Saskatchewan, an $11 million fibre optics manufacturing facility comprising a complete optical systems division, with integrated facilities for the

manufacture of optical cable and related electronic hardware, product-oriented R and D and world-wide marketing efforts.

Northern Telecom and Canstar, a subsidiary of Canada Wire and Cable, are presently the only Canadian manufacturers of glass fibre as distinct from cable. Northern has spent over $12 million on R and D for opto-electronic devices, optical fibre and optical cable and has made 37 related patent applications in Canada and foreign countries.

EXPANDING THROUGH R AND D

For several years, Northern Telecom has stressed market-oriented R and D as the road to success and such expenditures have, during the same period, consistently approximated six per cent of the company's manufacturing sales. The figure rose to seven per cent in 1978 as Northern moved ever more heavily into new product areas such as digital multiplexing systems, semiconductors and opto-electronics. Significantly, the company derived 72 per cent of its manufacturing sales from products of its own design in 1978 — up from 53 per cent in 1973.

In its early years, Northern did not have this enormous R and D capability. Before 1958, most of the designs and much of the technology employed by the company came from Western Electric. In that year Northern established a separate R and D organization to develop new products, the first step to making Northern largely self-sufficient in design and technology. The

company, however, retains to this day a licensing agreement with Western Electric and pays royalties of about $1 million a year to the U.S. corporation. This amount is offset by the royalties and license fees received from corporations which use Northern's proprietary information. For several years now, Northern has enjoyed a positive balance of trade in this regard.

Altogether, expenditures on R and D within the Bell-Northern family came to $151 million in 1978. Significant returns are required to justify such outlays. For example, for every dollar spent to develop the SP-1 analog switch, Northern received $10 in sales.

NTL and BNR spent directly $98 million on R and D in 1978 or about two thirds of the total for the Bell-Northern family (Table 2-7), while Bell Canada and the Bell telephone subsidiaries accounted for the major part of the rest of the Bell/Northern R and D outlays in that year. The vast portion of this money went to Bell Northern Research (BNR) which had a 1978 budget of $104 million inclusive of provisions for the software research carried out in Toronto.

Bell and its telephone subsidiaries spent most of their R and D funds on work in systems engineering by BNR. Northern and its subsidiaries allocated most of their R and D monies to work on hardware for communications equipment and electronic office systems.

In the future, Northern will spend even more money on R and D. Indeed, NTL and BNR spent directly and indirectly some $135 million in 1979 -- a 38 per

Table 2-7

R and D expenditures

by Bell, NTL

and their subsidiaries

	R and D Expenditures ($ millions)	
	1978	1977
NTL and BNR *	98	68
NTL specific contracts	5	4
Others (principally Bell Canada)	32	31
Total R&D at NTL and BNR	135	103
Bell Canada and its telephone subsidiaries	15	10
Total R&D in Bell/Northern Group	151	113
* NTL and BNR as per cent of manufacturing sales	7.3%	6.5%

cent increase over 1978 and the most ever spent as a proportion of sales by the company. Northern emphasized in its 1979 Annual report: "A long-term, consistent and growing research and development commitment is vital to our ability to remain in the forefront of the highly competitive telecommunications and computer industries."

THE TURNING POINT

The year 1979 was a turning point in the history of the Northern Telecom. For the first time, more than 50 per cent of the Northern family's revenues came from the U.S. and other foreign sources. Northern had long maintained that the U.S. market in communications equipment -- larger and more open than elsewhere and operating under the same technical standards as Canada -- constituted the company's greatest opportunity. That opportunity now seems on the verge of realization.

But an essential precondition for success in the U.S. has been a substantial local presence because most American customers prefer the assurance of a manufacturing source close at hand during the "life" of their investment, and some must obey the "Buy American" requirements imposed by the U.S. Rural Electrification Administration as a condition of financing or other assistance. The very competitiveness of the U.S. market also forces suppliers to participate directly as a means of anticipating technology changes and evolving customer needs.

Northern has responded to these pressures by changing its pattern of capital expenditure for manufacturing facilities. During the past decade, this expenditure came to $387 million, 70 per cent of which was committed to Canada. In 1979, the focus of activity shifted to the U.S.: 64 per cent of Northern's $135 million* in capital expenditures were outlayed in the United States.

Northern expects that its sales will reach $4 billion annually before the end of the 1980s and that, at that point, some 60% will be made in foreign markets. Inevitably, the rising proportion of foreign sales will entail a higher commitment of the company's resources outside Canada.

Office of the Future

NTL has streamlined its approach to "office of the future". Convinced that this area holds the key to important successes in communications equipment manufacturing in the eighties, the company has tasked its U.S. subsidiary, Northern Telecom Inc., with prime responsibility for producing and marketing this type of product. This decision, which relies equally on telecommunications and data control know how, points to an aggressive entry of NTL in this field which it has decided to penetrate as much from the switching/transmission end as from the terminal end.

* including $16 million in capitalized U.S. leases

Northern Telecom Limited

Manufacturing Facilities and Principal Products

CANADA

Switching

Brampton, Ont.
Digital, electronic and electro-mechanical switching systems, parts and components, peripheral systems

Calgary, Alta.
Electronic switching equipment, cable forming

Charlottetown, P.E.I.
Central office fuses

LaSalle, Que.
Step-by-step switching systems, power equipment, connectors, multiple cables and relays

Montreal, Que.
Sheet-metal and piece parts, machines, tools

St. John's, Nfld.
Networks and sensors, keys, jacks, resistors

Subscriber Equipment

Amherst, N.S.
Residential and business telephones and components

Belleville, Ont.
Electronic and digital PABXs, printed circuit boards, printed circuit packs, components, key telephone systems

London, Ont.
Residential and business telephone sets, parts and components

Regina, Sask,
Telephone sets, buzzers, modular hardware

Saint John, N.B.
Cables for PABXs, connector cables

Cable

Amherst, N.S.
Telephone wire and cable

Calgary, Alta.
Telephone wire and cable

Kingston, Ont.
Telephone and switchboard cable, enamel wire

Lachine, Que.
Communication wire and cable, power cable, building wire

Regina, Sask.
Telephone wire and cable

Transmission

Aylmer, Que.
Digital subscriber carrier equipment, digital channel banks and repeaters, hybrid circuits and components

St. Laurent, Que.
Multiplex, voice frequency and radio equipment, printed circuits packs, device testing

Winnipeg, Man.
Cable forming, digital transmission equipment

Repair and Overhaul

Calgary, Alta.
Repair and overhaul of telephone sets

Montreal North, Que.
Repair and overhaul of telephone sets, teletypewriters, switching and electronic equipment and data terminals. Calibration of instruments and manufacture of special assemblies

North York, Ont.
Repair and overhaul of telephone sets, teletypewriters, switching and electronic equipment and data terminals. Calibration of instruments and manufacture of special assemblies

Saint John, N.B.
Repair and overhaul of telephone sets and test sets.

Outside Plant

St. Laurent, Que.
Customer premises distribution systems, terminals and closures, splicing connectors, miniature protector connectors, loading devices, protection devices, auxiliary tools and devices

Winnipeg, Man.
Protection devices, central office protection connectors

UNITED STATES

Adelanto, Cal.
Repair and overhaul of telephone sets

Ann Arbor, Mich.
On-line terminal systems, distributed data processing systems, intelligent terminals, printers, disk drives, printed circuits boards

Creedmoor, N.C.
Digital switching systems

Concord, N.H.
Voice frequency and tests equipment

Goldsboro, N.C.
On-line terminal systems, printed circuit boards

Kevil, Ky.
Repair and overhaul of telephone sets

Minnetonka, Minn.
Disk drives

Minnetonka, Minn.
On-line terminal systems, remote batch terminal systems, multi-function terminal systems

Montevideo, Minn.
Printed circuit boards

Moorestown, N.J.
Data communications diagnostic test equipment, data communications patching and switching equipment

Morton Grove, Ill.
Outside plant equipment, tool data collection systems, loop treatment and voice frequency equipment, tape transports

Nashville, Tenn.
Telephone sets

Richardson, Texas
Computerized telecommunications switching for networks and PABX

Sanford, N.C.
Repair and overhaul of telephone sets

Santa Clara, Cal.
Electronic and digital PABXs

St. Paul, Minn.
Sheet metal fabrication

Tampa, Fla.
Repair and overhaul of telephone sets

Texarkana, Tex.
Repair and overhaul of telephone sets

Warwick, R.I.
Printers

West Palm Beach, Fla.
Printed circuit boards, printed circuit packs, hybrid circuits

BRAZIL

Rio de Janeiro
Outside plant equipment, protectors

GREAT BRITAIN

Hemel Hempstead
Card readers, cable assemblies, repair and refurbishment

Source: NTL Annual Report 1978

MALAYSIA

Penang
Heat coils, cable forms, capacitors, telephone set components, fuses, transformers

REPUBLIC OF IRELAND

Galway
Telephone sets, PABX systems, voice frequency equipment

TURKEY

Istanbul
Electro-mechanical switching systems, switchboards, telephone apparatus

Chapter 3

AEL MICROTEL

AEL Microtel is the product of an October 1979 merger between two companies, Lenkurt Electric (Canada) Limited and Automatic Electric (Canada) Limited, both previously owned by the U.S. General Telephone and Electronics (GTE). This merger was brought about by the British Columbia Telephone Company (B.C. Tel), another Canadian subsidiary of GTE. B.C. Tel purchased the two companies, which were its major suppliers, because it wanted to rationalize their operations and increase their efficiency and competitiveness in today's telecommunications equipment market.

Automatic and Lenkurt have long specialized in the manufacture of switching/subscriber equipment and transmission equipment respectively. In 1978, their combined total sales came to $151 million or one tenth of Northern's in the same year.

A NEW RELATIONSHIP

Before the formation of AEL Microtel, Automatic Electric (Canada) owned 100 per cent of Lenkurt Electric (Canada), while the U.S. multinational, General Telephone and Electronics Corporation (GTE), wholly-owned Automatic Electric (Canada) through its wholly owned subsidiary, GTE International Incorporated (GTEI). In 1978, GTE worldwide sales came to $8.7 billion, and the company employed 213,500 people. The two Canadian companies formed only a small part of their parent's global operation.

Indeed, these two companies are not its only Canadian subsidiaries. As Table 3-1 shows, the multinational holds a 100 per cent interest in Anglo-Canadian Telephone Company, a Montreal-based holding company for GTE Canadian telephone subsidiaries.

The largest GTE telephone subsidiary in Canada is the British Columbia Telephone Company (B.C. Tel), which operates out of Burnaby, B.C., and earned $576 million in operating revenues during 1978. B.C. Tel is second to Bell Canada among Canadian telecommunications carriers and operates 1.7 million telephones or 11 per cent of the national total. Anglo-Canadian Telephone Company has for many years held a controlling interest in B.C. Tel. Between 1974 and 1978, B.C. Tel bought more than 60 per cent of its equipment from Automatic and Lenkurt and accounted for 54 and 22 per cent, respectively, of Automatic's and Lenkurt's sales.

The relationship between B.C. Tel and its principal suppliers was complementary but raised question as to the independance of the carrier's procurement policy since it was ultimately controlled by a parent who also controlled, through a parallel intercorporate network, its principal suppliers. In October 1979, B.C. Tel purchased Automatic and its subsidiary, Lenkurt, from GTE for $49 million and merged the two to create AEL Microtel Limited. GTE still retains overall control through the Anglo-Canadian Telephone Company's majority interest in B.C. Tel but AEL Microtel is now directly answerable to B.C. Tel.

Table 3-1

Major Canadian subsidiaries
of the General Telephone & Electronics Corporation
(January 1981)

Name	Ownership	Remarks
Parent firm and U.S. holding company		
General Telephone & Electronics Corporation (GTE)		Headquarters in Stamford, Conn.
GTE International Incorporated (GTEI)	100% GTE	Voting control held via GTE Products Corporation
Canadian subsidiaries		
Anglo-Canadian Telephone Company	100% GTE	Headquarters in Montreal; holding company for the Canadian telephone subsidiaries
British Columbia Telephone Company (B.C. Tel)	45.9% Anglo-Canadian and 9.3% GTEI	Headquarters in Burnaby,

Name	Ownership	Remarks
Québec-Téléphone (Que. Tel)	53.8% Anglo-Canadian	Headquarters in Rimouski
AEL Microtel	100% B.C. Tel	Headquarters in Burnaby, B.C. Major plants in Brockville (switching) and Burnaby (transmission) About 3,000 employees
Microtel Pacific Research	100% AEL Microtel	Headquarters in Burnaby, B.C. Employs 230 people

Automatic has become Microtel's switching and subscriber division, which manufactures private automatic branch exchanges (PABXs), station apparatus and central office switching equipment at its facility in Brockville, Ontario. The division also makes telephone sets at a smaller plant in Lethbridge, Alberta.

Lenkurt has become Microtel's transmission division. It manufactures radio, multiplexing and other transmission equipment at its main plant in Burnaby, as well as other plants in Saskatoon and in Winnipeg.

AEL Microtel Limited and B.C. Tel have created an R and D subsidiary, Microtel Pacific Research Limited. The divisions of Automatic, Lenkurt and B.C. Tel focusing on product R and D were transferred to this new firm; however development work on manufacturing processes has stayed with the parents.

A JUSTIFICATION FOR MERGER

In 1978, Lenkurt had $48 million in sales, while Automatic had managed about twice as much -- $103 million. Both firms, however, had been experiencing severe declines in profitability, with their combined net earnings after taxes falling from $8.1 million to $0.5 million between 1974 and 1978 (Table 3-2). The rectification of this situation within a new organizational format was a major goal of the merger of the two companies. The decision may also have been influenced by the Consent Agreement which resulted in 1979 from long standing (1967 to 1978) court litigation in the United States between the International Telephone and Telegraph Corporation (ITT) and GTE in the matter of the Hawaian telephone Company (a GTE telephone subsidiary). The Agreement opened the GTE telephone system to competitive bidding thus potentially reducing the intra GTE market share of the GTE manufacturing companies and, by extension, the export prospects of the GTE manufacturing subsidiaries in Canada to their "cousins" in the United States.

Double trouble at Automatic

Automatic sold switching and subscriber equipment which it manufactured itself or distributed for other manufacturers. Its sales reached a peak of $153 million in 1976 but had declined to $103 million by 1978 (Table 3-2). Its sharpest sales decline (23.5 per cent) took place in 1977, and occurred mainly because of a large drop in sales of products distributed for other companies. These fell from a high of $53.8 million in 1976 to $20.9 million in 1978 (Table 3-3). In terms of earnings after taxes, the company was not quite breaking even in 1978.

Table 3-2

AEL Microtel

Sales and earnings 1974-78

	1978	1977	1976	1975	1974
Switching and subscriber division: GT & E Automatic Electric (Canada) Limited					
Sales ($ Million)	102.6	117.1	153.0	124.9	116.5
Per cent change from previous year	-12.4	-23.5	22.5	7.2	38.0
Net earnings after tax ($ Million)	- 0.15	0.17	5.1	5.2	5.8
Net earnings as a per cent of sales	- 0.15	0.15	3.3	4.2	5.0
Transmission division: GT & E Lenkurt Electric (Canada) Limited					
Sales ($ Million)	47.5	48.2	50.4	51.9	36.9
Per cent change from previous year	-1.4	-4.3	-2.9	40.7	19.7
Net earnings after tax ($ Million)	0.75	1.8	2.9	4.2	2.3
Net earnings as a per cent of sales	1.6	3.8	5.8	8.2	6.1

Source: Annual financial statements for predecessor companies.

Two types of distributed products accounted for most of the sales reduction. One was a line of wire and cable manufactured by Phillips Cables Ltd; it was discontinued causing a $25 million drop in sales. The other was a crossbar private automatic branch exchange (PABX) manufactured by Hitachi Limited, the Japanese multinational. Sales of this product went into a sharp decline after 1976 with the introduction of electronic equipment. Today AEL Microtel still distributes for other manufacturers such products as test equipment, intercom systems, automatic dialers, toll restrictors, traffic measuring systems, voice frequency terminating equipment and a miscellany of tools, supplies and hardware.

Automatic's sales of subscriber equipment rose from $16.5 million in 1974 to $21.9 million in 1978. Among these products are: the GTD 120A, a 120 line/28 trunk digital switch; the GTD 1000, a 1,000 line/256 trunk digital switch; and the GTD 4600, a 4,600 line/576 trunk digital switch. Also included are various types of station apparatus including telephone sets, pay stations, key systems, electronic secretaries (secretarial answering units) and enterphones (a security intercom for entranceways). Sales of the PABXs and station apparatus accounted for about one quarter of Automatic's total sales in 1978.

Automatic's sales of central office switching equipment rose dramatically from $46.4 million to $81.5 million between 1974 and 1976. However, by 1978, they had fallen to $60.2 million because of a general softening of demand in the Canadian market and because of the changeover from electromechanical to electronic technology. Automatic had anticipated these developments. In 1977, the company began conversion of its Brockville plant

Table 3-3

AEL Microtel

Sales 1974-78

($ Million)

	1978	1977	1976	1975	1974
Switching and subscriber division:	Automatic Electric (Canada) Limited				
Subscriber equipment	21.9	20.4	17.8	16.8	16.5
Central office switching	60.2	68.6	81.5	55.1	46.4
Distributed products	20.9	28.6	53.8	52.9	53.6
Total	103.0	117.7	153.0	124.9	116.5
Transmission division:	Lenkurt Electric (Canada) Limited				
Radio ($ Million)	3.8	5.2	5.8	3.8	2.4
Multiplex	20.0	26.4	31.0	34.7	24.5
Other	24.0	16.7	13.7	13.8	10.1
Total	47.8	48.3	50.5	52.2	37.0

Source: Interrogatory CRTC 300R, Acquisition of Automatic Electric (Canada) Ltd. by the British Columbia Telephone Company. Total sales in Table 3-3 differ slightly from Table 3-2.

into an efficient electronic manufacturing facility. The program required heavy capital investments with little expectation of a return for two or three years.

The central office switching equipment now produced by AEL Microtel includes:

1. the CI EAX, an analog local switch with a capacity of 7,600 lines,

2. the #1 EAX, an analog local and toll switch with a capacity of 45,000 lines/8,000 trunks,

3. the #2 EAX, an analog local switch with a capacity of 20,000 lines,

4. the #3 EAX, a digital toll switch with a capacity of 60,000 trunks,

5. CAMA, a centralized automatic message accounting system with access for 2,000 trunks, and

6. TSPS, an automated toll traffic service position with 320 operator positions.

AEL Microtel plans to introduce in 1982 a new electronic automatic exchange, called the #5 EAX, which it is developing jointly with Automatic Electric in the U.S. Because this exchange comprises an integrated family of digital systems and permits both distributed switching and centralized common

control, it will be suited for a wide range of urban and rural applications. Its elements include:

1. the small base unit (SBU),
   a local switch with a
   20,000 line/3,000 trunk capacity,

2. the large base unit (LBU),
   a local and toll switch with a
   145,000 line/25,000 trunk capacity,

3. the remote switch unit (RSU),
   featuring a 3,000 line capacity,

4. the remote line unit (RLU),
   a 768 line gain system, and

5. the multiplexor unit (MXU),
   a 96 line gain system.

Before its absorption in AEL Microtel, Automatic relied heavily on the domestic market, with Canadian sales accounting for almost 75 per cent of total sales in 1978 (Table 3-4), (a decline from approximately 86 per cent in 1974). The bulk of the company's Canadian sales were to GTE subsidiaries -- especially B.C. Tel. Between 1974 and 1978, sales to Canadian GTE subsidiaries declined by

one third to roughly 42.9 per cent of total sales but the reduction was offset by a significant rise in sales to other Canadian customers.

The American market for Automatic's products, reached through the U.S. Automatic Electric (another GTE subsidiary), grew significantly between 1974 and 1978. The rise in U.S. sales in the last two years of the period resulted mainly from a shortage of #2 EAX units in that country. In both years, U.S. sales for this product were almost twice what they were in Canada. The 1979 Consent Agreement in the matter of the Hawaian Telephone Company could, however, reduce the company's sales to the GTE operating system in the United States if the Automatic/Microtel combination is not fully successful in meeting the challenge of outside competition in that market.

GTE International handled sales of Automatic's products to foreign customers outside the United States. Between 1974 and 1978, these sales fell by about half as a proportion of Automatic's total sales. By 1978 only 6.2 per cent of Automatic's total sales were to foreign customers outside the United States.

Table 3-4

AEL Microtel

Per cent sales by customer group and geographic area 1974-1978

	1978	1977	1976	1975	1974
Switching and subscriber division:	Automatic Electric (Canada) Limited				
GTE Canadian subsidiaries	42.9	54.4	64.2	58.9	62.1
Other Canadian customers	31.8	30.3	25.2	28.6	24.4
GTE and its U.S. subsidiaries	19.1	7.0	1.0	1.0	1.3
Foreign customers except U.S.	6.2	8.3	9.6	11.5	12.2
Total	100	100	100	100	100
	($103.0 million)	($117.7 million)	($153.0 million)	($124.9 million)	($116.5 million)
Transmission division:	Lenkurt Electric (Canada) Limited				
GTE Canadian subsidiaries	12.8	27.9	31.6	26.5	26.6
Other Canadian customers	60.3	49.1	48.7	57.57	56.6
GTE and its U.S. subsidiaries	8.7	0.9	0.4	0.3	1.6
Foreign customers except U.S.	18.2	22.1	19.3	15.6	15.6
Total	100	100	100	100	100
	($47.8 million)	($48.3 million)	($50.5 million)	($52.2 million)	($37.0 million)

Source: Interrogatory CRTC 300R, Acquisition of GTE Automatic Electric (Canada) Ltd. by the British Columbia Telephone Company.

Lean years at Lenkurt

Lenkurt, now the transmission division of AEL Microtel, experienced in the latter 1970's conditions somewhat similar to those encountered by Automatic. Its sales, which had risen from $36.9 million in 1974 to $51.9 million in 1975 failed to make headway in subsequent years. By 1978, they had dropped to $47.5 million. More seriously, the company was experiencing a considerable decline in profitability, from $2.3 million in net earnings after tax in 1974 to $75,000 in 1978.

The Lenkurt multiplexing equipment included 60, 600, 1,200 and 1,800 channel analog systems as well as 24, 48 and 96 channel digital systems. Annual sales rose from $24.5 million in 1974 to $34.7 million in 1975, dropped to $31.0 million in 1976 and fell to $26.4 million in 1977. The demand for toll multiplexing equipment had decreased abruptly as a result of a lower than anticipated growth in long distance communications in British Columbia. In the next year, the situation further deteriorated and sales of the company's multiplexing equipment were held to $20 million. Sales of Lenkurt's microwave radio equipment also declined during the same period. This equipment included analog microwave radio equipment in the 2, 6, 7, 8 and 11 GHz bands, with a capacity of 60 to 1,200 voice channels. Sales had risen from $2.4 in 1974 to $5.8 million in 1976 but fell to $5.2 million in 1977 and $3.8 million in 1978. Lenkurt also had to absorb, beginning in 1977, the start-up costs for a new microwave radio equipment manufacturing plant in Winnipeg.

The company, however, managed to find lucrative new customers in B.C. Hydro and a variety of companies in other countries. Its radio sales by themselves brought in limited revenue, but the accompanying service charges to

customers other than telephone companies that do not engineer and install their own equipment came to generate significant results. Such customers often require turnkey services for complete systems -- including civil works, antennas and power. Lenkurt sold the necessary equipment, including echo suppressors, voice frequency terminal equipment, data modems capable of transmitting at 50 to 600 baud or from 2,400 to 4,800 bits a second, and minicomputer-based supervisory and control systems for unattended telephone exchanges and microwave sites, and provided the required associated services. Between 1974 and 1978, sales of this kind more than doubled, rising from $10.1 million to $24.0 million or more than half the company's total sales in 1978, and helped keep it in the black in 1977 and 1978.

Lenkurt, with about 73 per cent of its sales in Canada, has, like Automatic, been highly dependent on the domestic market. Within that market, however, it is much less reliant on Canadian subsidiaries of GTE (its dependence on these subsidiaries dropped by more than half between 1974 and 1978). Lenkurt has also looked less to the American market and the GTE subsidiaries which permit access to it. Thus the 1979 Consert Agreement arising out of the Hawaian Telephone Company case was unlikely to significantly affect its activities and prospects.

The firm has been successful in finding foreign customers outside the United States. In 1978, 18.2 per cent of its total sales were to such customers -- in contrast to only 6.2 per cent for Automatic. Though it exported its products to 32 different countries in that year, sales to foreign customers

outside the U.S. were lower as a proportion of its total sales in 1978 than in any year since 1975. As the transmission division of AEL Microtel, the firm has reversed this trend with recent contracts in Mexico and other countries.

R AND D: ROAD TO A BETTER FUTURE

Since 1974, R and D expenditures by Automatic and Lenkurt have grown at an average of 11 per cent a year. The two companies contributed equally to an R and D expenditure of $5.3 million in 1978 and employed 175 technical staff for this purpose. Yet each, because they make different products, has pursued a different R and D strategy.

Automatic has always had the capability to design a central office switch of modest size, but the cost of developing a large machine comes to $100 million; and even Automatic's successor, the switching and subscriber division of AEL Microtel, cannot justify this expenditure, given its share of the Canadian market. As a result, the company is likely to continue to adapt for the Canadian market the designs of Automatic Electric in the United States (the past exception in this regard being the Canadian developed C1 EAX). It will continue to perform ancillary R and D for certain U.S. designs as it does presently in the case of the #5 EAX where it has full responsibility for the remote switch unit and other peripheral equipment, which account for 20 per cent of the total cost of that project. AEL Microtel uses U.S. designs for telephone sets and the GTD line of private automatic branch exchanges (PABXs) introduced in 1977.

Lenkurt and its successor, the transmission division of AEL Microtel, are more able to pursue an independent R and D policy because transmission

customers other than telephone companies that do not engineer and install their own equipment came to generate significant results. Such customers often require turnkey services for complete systems -- including civil works, antennas and power. Lenkurt sold the necessary equipment, including echo suppressors, voice frequency terminal equipment, data modems capable of transmitting at 50 to 600 baud or from 2,400 to 4,800 bits a second, and minicomputer-based supervisory and control systems for unattended telephone exchanges and microwave sites, and provided the required associated services. Between 1974 and 1978, sales of this kind more than doubled, rising from $10.1 million to $24.0 million or more than half the company's total sales in 1978, and helped keep it in the black in 1977 and 1978.

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R AND D: ROAD TO A BETTER FUTURE

Since 1974, R and D expenditures by Automatic and Lenkurt have grown at an average of 11 per cent a year. The two companies contributed equally to an R and D expenditure of $5.3 million in 1978 and employed 175 technical staff for this purpose. Yet each, because they make different products, has pursued a different R and D strategy.

Automatic has always had the capability to design a central office switch of modest size, but the cost of developing a large machine comes to $100 million; and even Automatic's successor, the switching and subscriber division of AEL Microtel, cannot justify this expenditure, given its share of the Canadian market. As a result, the company is likely to continue to adapt for the Canadian market the designs of Automatic Electric in the United States (the past exception in this regard being the Canadian developed C1 EAX). It will continue to perform ancillary R and D for certain U.S. designs as it does presently in the case of the #5 EAX where it has full responsibility for the remote switch unit and other peripheral equipment, which account for 20 per cent of the total cost of that project. AEL Microtel uses U.S. designs for telephone sets and the GTD line of private automatic branch exchanges (PABXs) introduced in 1977.

Lenkurt and its successor, the transmission division of AEL Microtel, are more able to pursue an independent R and D policy because transmission

equipment is less expensive to develop than central office switches. With the exception of its microwave radio and pulse code modulators (designed by Lenkurt Electric in the United States), the entire transmission product line is largely of Canadian origin, including the 2 GHz microwave radio, echo suppressors, the highly successful 46A analogue multiplex and a minicomputer-based supervisory and control system sold to seven of the nine telephone companies in the TransCanada Telephone System (TCTS). Lenkurt and its successor, the transmission division of AEL, have also established an independent R and D capability for thick and thin film circuits.

Because of AEL's dependence on R and D imported from GTE's American subsidiaries, the Canadian company has to pay technical fees and royalties which vary directly with revenues gained from sales of U.S. designed products. In 1978, these payments came to $200,000 for transmission equipment and $2.3 million for switching and subscriber equipment. The difference in these amounts arises less from any difference in sales volume than from a greater independence in the area of transmission products.

In the future, the two divisions of AEL Microtel will continue to conduct their own development work on manufacturing processes and equipment, but R and D product work will be performed by Microtel Pacific Research Limited. This R and D subsidiary, which comprises parts of the R and D divisions of both AEL Microtel and B.C. Tel, undertakes projects in transmission equipment, terminal equipment, and the smaller switching applications. It has access to GTE laboratories under agreements existing with AEL Microtel's predecessors,

Automatic and Lenkurt. By 1984, Microtel Pacific will have spent some $16 million on R and D. It currently employs a staff of 230 (Automatic and Lenkurt had an aggregate R and D complement of 175 in 1978).

AEL Microtel will probably continue to pay $200,000 in royalties and technical fees to GTE for transmission equipment; its contribution for switching and subscriber equipment, however, is expected to rise to $3.5 million by 1984.

MAPPING OUT THE FUTURE

Having signified its intention to buy and merge Automatic and Lenkurt into AEL Microtel, B.C. Tel appeared in June 1979 before the Canadian Radio-Television and Telecommunications Commission (CRTC) to justify its course of action in that regard.[1] The telephone company offered a vision of the future for each company and then discussed how their combined operation would lead to even greater success.

According to B.C. Tel, "Automatic's fundamental role is to continue as a major domestic manufacturer of modern switching and subscriber equipment." As a means of attaining this goal, the telephone company said heavier investments in R and D would be necessary and, in particular, a concerted effort to develop "an integrated family of digital end office switches, utilizing concepts and components only now becoming available." At present, Automatic has an analog switch of very advanced design but, according to B.C. Tel, "a digital alternative is also required so that network planners have a choice of selecting the technology that best fits a specific application."

1. Interrogatory, CRTC, 312.

Lenkurt focuses on transmission equipment; and, according to B.C. Tel, is concentrating its current R and D work on "unique product lines aimed at the export market, but also saleable in Canada." These products include microwave equipment in specialized frequency bands. B.C. Tel also emphasized that the company has made "a major breakthrough in the cost and size of single channel multiplex equipment," and pointed to large orders for Lenkurt's System 51 supervisory and control equipment by American companies and by oil and gas pipeline organizations in Mexico and the Middle East. B.C. Tel also told the CRTC that Lenkurt is making even greater efforts to sell its transmission products to Bell Canada and "has every expectation of an increase in sales".

According to B.C. Tel, the merger of the two companies into AEL Microtel will mean a rationalization of their manufacturing and R and D activities which can bring significant benefits. The telephone company stated that "a major thrust will be the rationalization of component production between Automatic and Lenkurt." In the past, the two companies have tended to mechanize and/or specialize in different areas, with Automatic focusing on large, fine line, double sided and multilayer printed circuit boards and Lenkurt specializing in thin and thick film. For low volume devices, B.C. Tel foresees that "each major location will require capabilities in both these areas" but, for the large volume devices, it anticipates that "rationalization will permit cost reduction and allow investment in more sophisticated machinery which in turn will further reduce costs through better yields and greater density."

B.C. Tel expects that the benefits of rationalization will be most evident in the R and D work conducted by AEL Microtel and its R and D subsidiary. In particular, "the skills and knowledge of transmission and switching or subscriber design" will become "more freely available within a single organization".

These measures may have a definite impact on sales. It was learned recently that AEL Microtel has won its largest-ever contract worth $24 million to supply Hydro Quebec with 15 microwave relay stations along a 750 kilometre route linking Chibougamau in northern Quebec with the La Grande 2 station of the James Bay Power development. The contract follows another contract of $17 million which the transmission division of the company has completed for the Quebec utility. AEL Microtel predicts a nine per cent annual growth in sales over the next few years. By 1984, the company expects to top $250 million.

Another initiative towards this goal has been taken. The company has recently indicated that it plans to open a terminal equipment division. Using the Telidon technology as a starting point, the division will develop and produce an ever-expanding line of multi-faceted business terminals for the "office of the future".

At present, Microtel's main interest in office automation rests with user terminals where the longer production runs involved mesh nicely with the company's existing manufacturing and marketing practices.

The production and sale of these terminals will place AEL Microtel in direct competition with Northern Telecom and other Canadian manufacturers in this rapidly expanding market. The company's links to the GTE organization may also provide it, at the opportune moment, with a ready access to the U.S. market.

Chapter 4

THE MIDDLE RANGE

There is an important group of communications equipment manufacturers with annual sales between $10 million and $100 million. These companies, with no special ties with carriers still play a significant role in the activities of the communications equipment industry. As Figure 8-1 reveals, the combined sales of 14 of these companies came to almost $600 million in 1978 nearly four times those of AEL Microtel. Many provide equipment and services which Northern Telecom and AEL Microtel do not supply, and some are operating in areas which may develop rapidly in the next decade.

A chronology of these firms by date of establishment roughly recapitulates the history of technological development in communications in Canada. For example, the oldest firms, most of them founded around the turn of the century, produce wire and cable, the earliest transmission medium. The next oldest produce mobile radio systems using off-air transmission and were founded before 1950. A new kind of off-air transmission emerged in the 1950's: microwave links for transmission of heavy traffic over long distances. This new technology began to be used in the early 1960s in satellite communications and companies arrived on the scene to capitalize on this opportunity. In the 1970's, when data communications and telecommunications technologies began to merge, a few innovative firms were established to exploit the resulting possibilities.

WIRE and CABLE MANUFACTURERS

Two of the three leading firms specializing in the manufacture of power and telecommunications wire and cable* were established in this country around the turn of the century. Their arrival followed the discoveries of electricity and telephony and the use of metal as the most obvious transmission medium for their signals. For much of their history, these companies enjoyed steady if unspectacular growth; in the last few years, however, their aggregate sales declined, partly because of worldwide fluctuations in the price of copper, partly because of unsettled conditions in the domestic construction industry, and partly because of a general oversupply situation which coincidentally developed in the Canadian wire and cable manufacturing industry.

Canada Wire and Cable

Founded in 1911, Canada Wire and Cable is a wholly-owned subsidiary of Noranda Mines Limited. The company regards itself as a "single product entity" and is the largest wire and cable company in Canada, producing a broader range of products than any other firm. In 1977, the company had 2,500 employees in 12 manufacturing facilities with accompanying sales offices and warehouses across Canada and in various establishments in Central America, South America, Australasia, South Africa, Nigeria and Iran.

Canada Wire and Cable produces cable for the transmission of electricity, mainly for use in the construction and appliance industries, as well as cable for voice and data transmission. The company has about one third

* There are in fact four leading wire and cable manufacturers in Canada. Northern Telecom also manufactures telecommunications cable but does not specialize in it at the exclusion of other lines. (see Chapter 2)

of the domestic market for power cable with its main competition in this area coming from Phillips Cables and Pirelli.

Canada Wire and Cable carries out little R and D on power cable as it meets existing public utilities' specifications in that regard. The company did, however, pioneer the use of polyethylene insulation for power cable and the substitution of aluminum for oil-encased cable to meet unusual conditions in the construction of the Churchill Falls hydro project.

The company began producing cable for telecommunications purposes in 1956 in competition against Northern Telecom and Phillips. It currently receives 25 per cent of its revenues from that source. It moved into fibre optics technology in 1973, acquiring the North American rights to the Phasil system for extruding strands of glass fibre. In 1977, it formed Canstar Communications Limited, a wholly-owned subsidiary, to develop fibre optics cable for integrated networks that can provide telephone, cable TV and other telecommunications services over a single system.

Canstar Communications now offers complete systems and optical fibre products for voice and data communications applications in five major product areas: computers, energy, telecommunications, defence and industrial control. The company consists of two divisions, employing 70 scientists, engineers and support staff. Its systems division designs, assembles and installs integrated networks along with the necessary electronics, while the manufacturing division produces the fibre strands and sheathes these strands into cables.

Canstar has thus far succeeded in producing low frequency fibre for short haul purposes -- that is, for buildings, boats and inter-office networks.

Recently, as a member of a consortium of five cable-TV companies, the company installed in London, Ontario, a six-fibre experimental cable to explore the feasibility of transmitting TV signals in digital form.

In 1977, Canada Wire and Cable devoted three per cent of its value-added* to R and D, mostly in the telecommunications area, and used the facilities of the Noranda research centre and Canstar Communications. Because the Canadian market may not be large enough to support an intensive R and D effort, especially in the fibre optics area, the company seems intent on seeking markets in the United States.

Phillips Cables

Phillips was founded in 1889 shortly after the invention of the telephone. It is one of the oldest surviving manufacturers of wire and cable equipment in Canada. For the next 60 years, the company manufactured a variety of electrical equipment, as well as wire and cable. It was split in half in 1953, with Automatic Electric purchasing the electrical division and British Insulated Callender Cables (BICC), a multinational company based in the U.K. and one of the largest cable manufacturers in the world, acquiring its cable division and subsequently incorporating it as Phillips Cables; BICC still possesses a 54 per cent interest in Phillips, while the General Cable Company, another multinational and the second largest cable manufacturer in the United States, owns 27 per cent of its voting stock.

* Which may translate into something of the order of one to one and a half percent of its revenues.

Phillips had its best year ever in 1974 when its revenues reached almost $200 million. About $160 million of this amount came from sales of power cable and business wire and the rest from sales of telecommunications cable. Still Phillips' 1974 revenues were negligible in comparison to those of its parents which together had sales of telecommunications cable equal to the total sales of cable of all types on the Canadian market.

Between 1974 and 1976, Phillips' revenues fell from $200 million to $100 million. The entry of Pirelli (see next section) into the Canadian telecommunications cable market at that time coincided with the onset of a global downward turn in cable manufacture and sales: a situation of oversupply developed which ultimately called for a rationalization of cable production in Canada. In early 1980, Northern Telecom and International Telephone and Telegraph (ITT) moved out of power cable after having sold their facilities to Phillips.

Phillips manufactures a wide range of telecommunications wire and cable at five Canadian plants, each scaled to the size of its regional market. About 70 per cent of production is telephone cable, including duct cable and cable for aerial and underground use, while some 12 per cent is switchboard wire and cable. Telephone wire, telephone cords and TV and radio cable account for another 17 per cent. Roughly 70 per cent of all telecommunications wire and cable is manufactured to order and sold to telephone companies.

In 1977, the company began carrying out R and D on fibre optics, mainly experimenting with two types of sheathing. In collaboration with Lenkurt which supplied terminal hardware, lasers, diodes and electronics, it developed a product with a loss factor of four decibels for every kilometre the light

impulses travel. Much of the funding for this work came from Phillips' power cable business.

Phillips has but a small staff engaged in development work -- less than one per cent of its total Canadian work force of 1,500. Despite this small commitment, the company has developed a method of bonding plastic to aluminum (the Glover barrier) and a foam-type insulation called "Celseal". Research performed at BICC and General Cable is also available to the Phillips Company on a contract basis.

Pirelli Cables

Pirelli Cables is a wholly-owned subsidiary of Pirelli Canada, a holding company which in turn is 40 per cent owned by Dunlop Holdings of the U.K., 20 per cent by the Italian Pirelli SPA and 40 per cent by the Swiss-based Société Internationale Pirelli, one of the two largest cable companies in the world. The Swiss firm exercises control through its ownership of 10 extra shares and has total annual revenues from all sources of about $2.25 billion. In 1978, the Swiss firm acquired for $60 million the power cable division of the General Cables Corporation, which owns 27 per cent of Phillips Cables.

Pirelli Cables entered the non-telephone wire and cable manufacturing business in Canada when it bought Cables Conduits and Fittings in 1953. It entered the Canadian telephone cable manufacturing business in 1974 with the construction of a plant in Guelph, Ontario followed by another in Surrey, British Columbia in 1976. It has since become the third largest Canadian

manufacturer of both electrical and telecommunications cable. The company produces a wide range of power cable, business wire supertension cable and magnet wire, and manufactures a less comprehensive line of telecommunications cable. It focuses primarily on plastic insulated, aluminum sheathed PCM cable. Pirelli imports much its raw material and exports some telecommunications cable products to developing countries such as Pakistan, Nigeria and Brazil.

Pirelli has 800 employees. Of these, 80 produce telecommunications cable and 20 are employed in R and D. Pirelli's development work adapts the firm's products to Canadian conditions or to the specifications of the Canadian carriers. It consists mainly of testing new materials or of devising new and more efficient methods of production.

2.2 per cent of Pirelli's sales revenues go to its parent company as payment for technical expertise. The monies are used to finance the three main R and D centres operated by the Société Internationale Pirelli in the U.K., Italy and Brazil.

MOBILE RADIO MANUFACTURERS

During the 1920s, mobile one way radios were developed for the automobile. They were followed during the Second World War by small portable radios for two way or multipoint communication. In the ensuing years, were developed the modern mobile two way radio systems now marketed throughout the world.

The two major Canadian producers of mobile radio systems, Motorola Canada and Canadian General Electric, are foreign owned but have a large manufacturing presence in Canada. Their main competitors for the Canadian market all do manufacturing or assembly work in Canada and import products from abroad. These include International Systcoms, Pye, Marconi, ~~Lynbrook~~ Lenbrook Industries, Glenayre Electronics, Western Radio and RCA.

In recent years, the Canadian mobile radio equipment market has been limited by the congestion of the mobile radio frequency bands in the larger cities. Recently, spectrum use has been re-allocated to permit the operation of mobile radio services on the 800 MHz band, a development which may increase the market for mobile radio systems and stimulate producers to provide new services and products.

Motorola Canada

Motorola Canada is a subsidiary of Motorola Incorporated of Chicago, which first entered the mobile radio business in 1928 and began in 1947 to manufacture portable two way radios in Canada. It was not until 1964 that the U.S. company introduced the first solid state two way mobile radio and it was not until 1966 that it began to produce it in Canada.

The parent company operates 37 plants in 16 countries and manufactures communications products in the United Kingdom, Germany, Israel, Australia, Mexico and South Africa, as well as Canada. Its net 1979 revenues came to $2.7

billion, with 37 per cent ($1 billion) derived from sales of communications products and a further 31 per cent derived from sales of microprocessors and integrated circuits.

Employment at Motorola Canada in 1978 numbered 1,000 while sales revenues came to some $84 million with communications products accounting for 67 per cent of the total. Some 40 per cent of total sales involved equipment manufactured in Canada. Components imported from the U.S., such as semiconductors, capacitors and resistors, constituted about 20 per cent of the content of manufactured products. Exports which generated some two to three per cent of total sales revenues went mainly to the U.S. parent, other Motorola affiliates and to U.S. railroads.

The Canadian company has four divisions: communications, automotive products, semiconductor products, and military and aerospace electronics. It manufactures a wide range of radio communication products -- with the exception of CB radios -- at its main plant and head office in Willowdale, Ontario. It is one of Canada's largest manufacturers of mobile radio communication products, selling mostly simplex systems, with the exception of the duplex "Pulsar", permitting simultaneous two way voice traffic. It has a near total capability in the design, selling and servicing of VHF and UHF mobile and portable radio systems, fixed-site base station equipment, tone only or tone and voice pagers, and closed circuit TV and remote alarm systems for industrial purposes.

The company sells 10 per cent of its radio and base station equipment to telephone companies, with the remainder going to radio common carriers, CN and CP rail and public safety and law enforcement agencies such as the RCMP. Motorola recently won a contract to supply a significant proportion of the equipment used in Bell Canada's Access 450 Automatic Mobile Telephone System (AMTS), which the carrier introduced in 1976-1977. Motorola Canada supplies the radio and necessary base station equipment -- a system operating in the 450 MHz range and offering 12 channels.

The common carriers constitute the largest market for Motorola Canada's pagers. These tone-only or tone and voice paging systems and one or two-address devices for intra-city or in-plant use can serve 100,000 subscribers on a single channel.

The company conducts R and D at its Willowdale plant where it employs about 60 engineers. Three per cent of its Canadian sales revenues are spent on R and D, (compared to seven per cent by its parent and parent's affiliates in the U.S). The Canadian effort focuses on product design or on the adaptation of American products to Canadian conditions; more theoretical or exploratory research is conducted in the United States. Because the size of the Canadian market limits the money a company can spend on R and D, Motorola is one of many foreign-owned Canadian companies to recognize the need for a worldwide product mandate from their parents to ensure wider distribution of products designed and developed in this country.

Canadian General Electric

First incorporated in 1892, the company was acquired in 1923 by General Electric Company, an American multinational. In 1962, CGE bought Dominion Engineering Work Limited, a manufacturer of heavy industrial equipment, turbines, generators and rolling mills and other equipment for the pulp and paper industry. In 1977, it formed an affiliate, Canadian Appliance Manufacturing Limited, into which it merged its own appliance business and that of a competitor, General Steel Ware (GSW); this affiliate later took over Westinghouse Canada Limited.

CGE's 1978 revenues from all sources came to slightly more than $1 billion. The company and its affiliates employed over 18,000 persons and operated 25 plants in Canada, mostly in Ontario and Quebec, as well as a network of service centres for its non-communications products. Its communications products division accounted for some three to five per cent of total sales revenues and exported little to other countries. The division has 160 employees engaged in the manufacture of mobile radio and base station equipment at its Toronto plant.

The company's 1978 sales of mobile radios came to some $10 million. Approximately 75 per cent of the products involved were manufactured in Canada. CGE performs little R and D on its communications products.

The lack of VHF and UHF channels for use by the general public has limited radio sales, especially in the Toronto area. Consequently, CGE's

marketing strategy has been to supply large self-contained systems to utilities and federal and provincial law enforcement agencies. The recent allocation of frequencies in the 800 MHz band to mobile radio use should, however, stimulate product development and sales of general purpose equipment.

MICROWAVE AND SATELLITE SYSTEM EQUIPMENT MANUFACTURERS

The emergence of microwave systems after the Second World War brought to the fore a new technology for transmitting large amounts of information over long distances. In the early 1960s, this technology took on a more powerful dimension with the advent of the communications satellite.

Many manufacturers of radio equipment moved into the microwave field soon after the new technology had proven itself. Four such firms, all foreign owned, are described below. With the advent of the communications satellite, two of them began to provide space equipment and earth stations. Yet it is a new, wholly-owned Canadian firm, Spar Aerospace, which has become the primary manufacturer of equipment used in Canadian satellite communications systems.

Canadian Marconi

Incorporated in 1903, Canadian Marconi is 51 per cent owned by General Electric Corporation, the U.K.-based multinational. It employs 2,000 people and has its headquarters and plant in Montreal. It has an American subsidiary, KAAR Electronics Corporation.

Canadian Marconi manufactures high technology products for defence and civil use. Its avionics and marine-land communications division makes land, sea and airborne navigational aids and satellite positioning systems, as well as a full range of fixed, mobile and portable radio equipment in the VHF and UHF bands. Its telecommunications division manufactures and markets commercial and military land-based microwave systems and test equipment. Its special services division provides installation services, repair and maintenance.

The company sold $81 million worth of electronic products and services in 1978-79. Its recent customers have included Canadian hydro companies, U.S. defence agencies and the British Post Office. The latter has awarded the company a $50 million contract for telex switching equipment.

The company's commitment to R and D has been growing over the years. Its activities in this area absorbed $2.8 million or about 3.5 per cent of its revenues in 1978-79. It announced in 1979 the establishment of a new R and D facility in Ottawa to complement its Montreal activity in this area.

Raytheon Canada

Raytheon Canada is a wholly-owned subsidiary of the U.S.-based Raytheon Corporation. It was incorporated in 1956 and has since conducted business from Waterloo, Ontario. Its work force, which has fluctuated widely in recent years, numbered 250 in 1978.

The company's present activities are the design and manufacture of electronic products and systems for telecommunications and air traffic control

purposes. It produces primary and secondary radar, weather radar, navigational aids and displays for air traffic control purposes; FDM/TV microwave systems, digital microwave systems and digital multiplex systems for land-based microwave services; television receive only (TVRO), television receive and transmit (TVRT) and single channel per carrier (SCPC) satellite earth stations.

The company's current annual sales approximate $12 million and are split evenly between telecommunications and air traffic control systems. Sales for both areas have hovered around the same level for the last 10 years. Raytheon's Canadian customers include most of the major telephone companies, Telesat Canada, CNCP Telecommunications and the federal Department of Transport. With the assistance of the Canadian International Development Agency (CIDA), the company has also sold abroad.

Raytheon's major competitors for sales of air traffic control systems are either foreign-based or foreign-controlled. For the company's other products however, the competition is Northern Telecom, AEL Microtel and Farinon which have significant shares of the market for domestic terrestrial microwave systems while SED Systems and Spar Aerospace are very active on the earth station front.

Some of Raytheon's products were developed in Canada but the company on the whole relies on its U.S. parent for new technology.

Rockwell Collins Canada -- Collins Canada

The U.S. multinational, Rockwell International Corporation, owns the Toronto-based Rockwell International of Canada. The Canadian subsidiary employs 3,200 people and has three divisions: Collins Canada, its electronics division; an automobile parts and components division; and a division which makes flow control equipment, printing presses and power tools.

These divisions operated 35 manufacturing plants and earned revenues of $320 million in 1979. Exports accounted for 66 per cent of sales; 40 per cent of revenues were spent on imports.

The Collins Canada division of Rockwell was established in 1954 as a subsidiary of the U.S. firm, Collins Radio. During the 1930s, Collins Radio became a leading supplier of radio equipment to U.S. defence agencies, a business which grew significantly during the Second World War. In 1972, Rockwell International acquired Collins Radio and its Canadian subsidiary, as well as other subsidiaries and service centres in Europe, Latin America, Australia and the Far East.

At present, the Collins Canada division provides maritime communications systems for private users and the Canadian and U.S. armed forces, microwave networks for Canadian hydro and transport utilities and transmitters for broadcast companies in Canada and in New Zealand. Fourteen countries now use its domestically designed portable UHF transceiver, featuring thin-film, integrated circuits and a high stability frequency synthesizer for rugged

applications. In 1979, the Collins Canada division won a $64 million contract from the Argentinian government to install a 23 station high frequency communications network.

The division has three branches in Ontario including its main manufacturing facility in Toronto where 400 persons are employed in the production of data microwave and audio/video distribution systems as well as air, land and marine communications systems in the medium to ultra high frequency range. The division also provides a complete range of support, installation and maintenance services.

The Toronto plant has a team of engineers and technicians for R and D work which receives back-up support from other Collins facilities. The work focuses on the development of advanced production techniques and on the achievement of a total manufacturing capability.

Farinon Canada and Farinon SR Systems

Farinon Canada is a subsidiary of the U.S.-based Harris Corporation. It was established in 1964 to meet the Canadian demand for low and medium density microwave radio systems. Sales have increased steadily from $1.5 million in 1969 to about $12 million a decade later. The company employs 215 people at recently expanded facilities in Dorval, Quebec, and sells equipment to Canadian telephone companies and other domestic users. It also exports to more than 100 countries around the world. Its main Canadian competitor is AEL Microtel's transmission division with Raytheon and Northern Telecom posing a threat in certain product areas.

The company designs and develops products for the Canadian and export markets and has well equipped facilities for manufacturing prototypes. It relies extensively on R and D performed by its U.S. parent but its Canadian R and D expenditures approximate five per cent of sales -- a relatively high level for a firm of this size.

In 1975, a new company called Farinon SR Systems was formed to manufacture and market a microwave subscriber radio (SR) system developed by Farinon Canada and designed to serve telephone subscribers in rural areas where cable distribution is uneconomic. The equipment consists of one or more central stations and a number of outlying stations, each capable of serving up to six subscribers located within its radio range. Farinon SR has found a sizeable market in Canada and abroad for its products; 70 per cent of its sales have been to foreign countries. The firm currently employs 50 and its facilities are to be expanded in the near future.

Spar Aerospace

Spar is Canada's leading satellite communications contractor. Founded in 1967, the company entered the space and terrestrial communications business in 1977 by acquiring a substantial portion of the facilities of the government and commercial systems division of RCA in Ste. Anne de Bellevue, Quebec. Subsequently it acquired from Northern Telecom and established in Kanata, Ontario, a satellite systems group specializing in the manufacture and test of specialized electronics for satellites. Spar's sales amounted to $91 million in 1978. It employed in that year 1,745 people at four locations in Canada and one in California.

Spar was, until recently, extensively involved with microwave radio relay systems. This activity, which is being gradually wound up, resulted from its acquisition of the RCA facilities at Ste. Anne de Bellevue. RCA had commenced work on radio relay systems in 1946 when it began supplying VHF and UHF systems to Canadian National Telegraph, Canadian Pacific Telegraph, Ontario Hydro and B.C. Tel. In the early 1950s, it developed a 2 GHz family of microwave systems with capacities of up to 120 channels that was later purchased by the Department of National Defence and Quebec Hydro, as well as by customers in Brazil, Israel and the United States. In the late 1950s, RCA developed a 600 channel system operating in the 2 and 6 GHz frequency ranges. It was used in the Trans-Canada microwave service, the Canada-Alaska microwave network, a Turkey-Iran-Pakistan system, a Mexico Olympic Games link, a trans-USA system and a Nile Valley system, as well as in extensive systems in Liberia, Brazil and Colombia. In the 1960s and 1970s, RCA developed a family of solid state microwave radio relay systems to replace the early tube versions. They operated at 2, 4, 6 and 7 GHz with capacities of up to 1,800 channels and enjoyed wide acceptance throughout the world. In 1978, Spar was still installing them in Nicaragua and Pan West Africa, as well as in Canada. The company's decision to drop this activity reflects its intention to focus its attention and resources into the space communications area.

Satellites have played a significant role in the success of RCA/Spar. As early as 1962, the company supplied RCA Astro Electronics, the prime contractor in NASA's Project RELAY, with the wideband transponder used in the satellite which became the precursor to the Intelsat global satellite system. With this experience, it built in the late 1960s a strong satellite engineering team through participation in the scientific satellite programs run by NASA and

the Canadian government. It provided components for the Alouette I and II, ISIS I and II, Pegasus and Atmosphere Explorer satellites.

In the 1970s, RCA/Spar specialized for the most part in design and supply of communications transponders and antennas. These subsystems were or will be provided under the following programs:

Program	Sponsor	Frequency Band	Number of Spacecraft
HERMES	Canadian Department of Communications	14/12 GHz	1
SATCOM	RCA	6/4 GHz	3
ANIK B	Telesat Canada	6/4 & 14/12 GHz	1
TDRSS	NASA and Western Union	6/4 GHz	6
ANIK C	Telesat Canada	14/12 GHz	3

Spar has steadily increased its role in the production of Canada's communication satellites. Although the prime contractor for the Anik C satellites is an American firm, Spar will perform the final integration and testing of one of the satellites, while supplying sub-systems for all three. In the case of the Anik D satellites, Spar is the prime contractor.

RCA/Spar has also fared well with earth terminals to receive and/or transmit communications satellite signals. The company (as RCA) had entered this field in 1959 when it carried out work on antenna feed systems in the Mojave desert at the deep space instrumentation facility operated by the U.S.

Jet Propulsion Laboratory. It next developed and manufactured Canada's first 6/4 GHz satellite terminal which was installed in Mill Village, Nova Scotia, in 1963. The terminal is used in the Intelsat system and the advanced satellite system operated by the U.S. National Aeronautics and Space Administration (NASA).

Over the years, RCA/Spar sales of satellite earth stations have exceeded $100 million. The decision to allow independent ownership of earth stations used to communicate with Telesat Canada satellites has created additional market opportunities for Spar. As a matter of fact it recently sold 35 satellite earth receiving stations to members of La Société d'édition et de transcodage T.E. (La SETTE) valued at more than $800,000.

Spar reports to have invested an amount equal to 3.3 per cent of its sales revenues in R and D in 1978. This figure may not tell the full story, however, if it does not include product development work under contract.

MANUFACTURERS OF SPECIALIZED ELECTRONIC PRODUCTS

The convergence of computer and telecommunications technologies has opened up a new horizon of opportunity for communications equipment manufacturers in Canada and a host of small firms have recently emerged to take advantage of the situation. Of these firms, two stand out: Gandalf and Mitel. Both are Canadian owned, are succeeding in foreign and domestic markets, expend a high proportion of their revenues on R and D and manufacture specialized products at the leading edge of technological development.

Gandalf

Gandalf was founded in 1970. Headquartered in Ottawa, it employs about 475 people worldwide and has branches in Montreal, Quebec City, Hull, Toronto, Calgary and Vancouver. It has two affiliates: the recently established Gandalf Digital Communications in the U.K. and Gandalf Data Incorporated which was established in 1974 in Illinois. The company supplies the computer industry with limited distance modems (devices to convert computer information for transmission over telecommunications systems) and private automatic computer exchanges (PACXs).

The limited distance modem originally had a 5 to 20 mile range and was designed for private inter-office communications or for local loops accessing the digital Dataroute network operated by TCTS. The device was unique in the early 1970s in that it consisted of a DC coupler that could be used directly over copper pairs to interconnect (at significant savings) data equipment over short distances. Other companies have since entered the field: the multinational Racal-Milgo and the U.S. Codex, a Motorola subsidiary, which penetrated the Canadian market by acquiring the Ontario modem-maker, ESE. Gandalf has now expanded its product line to more than 30 modem-type devices for asynchronous and synchronous data transmission over the short and long haul.

Gandalf's second product line is the PACX which provides a switching point between the terminals and the host computer of a modem-constituted limited private network, thereby allowing computer port selection and computer port contention. The PACX eliminates the need to go back to the public switched network to have a switching function performed for the limited distance network. It also increases the security of the limited access network by making it less accessible from the public switched network. Carriers, banks, financial

institutions, government departments and university computing centers use PACXs. TCTS sells them to its customers. As of November 1978, 250 had been sold and were in use.

A recently developed Gandalf product is the X-25 "Depacker" which can link 32 asynchronous computer ports to the digital packet-switched Datapac network of TCTS. Another is an intelligent data concentrator which multiplexes 32 data links into a single high speed link.

Gandalf's products are intended for use in local digital links between terminals and their host computers. They have evolved in nine years through four generations of computer/communications technology and currently employ digital transmission and microelectronics. The company's products are meant to complement the offerings of Canadian carriers in the data transmission area. Along with two or three other companies, Gandalf was able to establish a reliable market for its high technology products because it successfully anticipated the needs of TCTS when that consortium developed its digital and packet switching networks, Dataroute and Datapac.

Since 1970, Gandalf's sales have grown at an average annual rate of more than 50 per cent to $13 million in the company's fiscal year ending July 1979. The Canadian operations accounted for about 60 per cent of this figure and U.S. activities for most of the rest. The company reports that its 1980 sales will rise to $21 million.

Gandalf manufactures more than 80 per cent of its products in Canada. It imports medium and high speed modems from American companies such as Paradyne to fill special orders by Canadian customers. Roughly 50 per cent of its Canadian production is exported. The company's U.S. subsidiary imports half of its products from Canada and manufactures the rest, sending royalties to Canada for technical expertise and patent rights. In countries other than the U.S. or the U.K., Gandalf relies on local distributors, such as Dextraferm in Sweden and Eurotech S.A. in Belgium.

Gandalf's commitment to R and D is remarkable. It absorbs the time and energy of one out of every five members of its professional staff and entails an expenditure equal to 10 per cent of the company's revenues. All the firm's R and D work is carried out in Canada.

Mitel

Mitel was founded in 1971 and became a public corporation in 1979. It has its head office and principal manufacturing facilities in Kanata, Ont. It also has subsidiaries in other parts of Canada, the U.S., Europe and Hong Kong. The most important Mitel subsidiary is Mitel Semiconductor, an integrated circuit designer and manufacturer founded in 1977 and located at Bromont, Que.

In 1978-79, the company operated seven plants and employed 679 people (Table 4-1). Approximately 50 per cent of its work force was involved in manufacture and assembly while 30 and 20 per cent was employed in R and D and in marketing/administration, respectively.

Mitel is interested primarily in the design, development, manufacture and marketing of telecommunications equipment and large scale integrated (LSI) circuits. The firm's major telecommunications products to date have been tone receivers and generators, tone-to-pulse converters and its SX-200 and SX-20 private branch exchanges (PBX). The company recently developed and introduced a mini PBX, the SX-10, which handles 10 private lines and may be the smallest of its kind in the world. Other Mitel products include dialed digit displays, tone dial systems, intercoms and speed tone dialers. The Bromont subsidiary, Mitel Semiconductor, has developed in its first three years nine LSI circuit products for the use of its parent and other electronic equipment manufacturers. Indeed two thirds of the Bromont firm's 1978-79 production were sold to other electronic equipment manufacturers.

As Table 4-2 shows, Mitel's sales and net income have doubled or done better in just about every year since 1974.

Table 4-1

Mitel's manufacturing facilities, products and workers employed (1978)*

Location	Number of employees	Products manufactured
Mitel Corporation Kanata, Ontario	320	All Mitel telecommunications products
Mitel Semi-Conductor Inc. Bromont, Quebec	90	LSI circuits
Mitel Inc. Ogdensburg, New York	131	All Mitel telecommunications products
Mitel of Delaware Inc. Deerfield Beach, Florida	36	Private branch exchanges
Mitel Caribe Inc. Catano, Puerto Rico	50	Tone receivers and tone-to-pulse converters
Mitel International Limited Shannon, Ireland	44	Tone receivers and tone-to-pulse converters
Mitel Telecom Ltd. London, England	8	Dialed digit displays
	679	

* As of the end of January, 1981, Mitel reported having 2,050 full-time employees.

Table 4-2

Mitel's sales and net income by product area (1974-79)

	Years ending February (thousands of dollars)					
	1974	1975	1976	1977	1978	1979
Telecommunications equipment	$12	$315	$1,526	$4,690	$9,623	$18,384
LSI circuits	-	-	-	237	1,265	1,872
Licensing agreements	-	-	-	480	640	1,396
	$12	$315	$1,526	$5,407	$11,528	$21,648
NET INCOME (LOSS)	$(40)	$25	$159	$501	$1,146	$3,096

The large increase in Mitel's sales and net income during 1978-79 stemmed mainly from the introduction of new telecommunications products such as the SX-200 superswitch. The firm sold 39 per cent of its products through distributors, while telephone companies, telecommunications equipment manufacturers and other customers directly accounted for 31, 17 and 13 per cent of the remainder, respectively. The company had sales in the order of $40 million in its 1980 fiscal year and anticipates breaking the $100 million sales mark in its 1981 fiscal year. It recently won a $14 million contract from the British Post Office (BPO) for the supply of some 500 PBX units.

Table 4-3 shows that Mitel's reliance on the domestic market diminished rapidly from 1976-77 (47% of total sales) to 1977-78 (26% of total sales). This tendency was reinforced in 1978-79 when its ratio of domestic to total sales fell to 21%; it will be further bolstered by the impact of the BPO contract. In dollar terms, the largest gain in the company's sales outside Canada took place in the U.S. (from 34% of total sales in 1976-77 to 61% in 1978-79). Foreign

Table 4-3

Mitel's Sales by geographic area (1977-79)

	Year ending February (thousands of dollars)					
	1977		1978		1979	
	$	%	$	%	$	%
United States	1,853	34	6,622	58	13,151	61
Canada	2,525	47	3,022	26	4,578	21
Other	1,029	19	1,884	16	3,919	18
Total	5,407	100	11,528	100	21,648	100

sales elsewhere were dominated until 1981 by two licensing agreements with a Czeckoslovak state agency that permit the agency to acquire Mitel's expertise in computer aided design techniques for LSI circuity and to manufacture and market some of Mitel's LSI chips, the SX-200 Superswitch and the large SX-2000. The situation will change as a result of the BPO contract.

Mitel's R and D commitment has grown with its sales. The company's related outlays nearly tripled from 1976-77 to 1978-79, expanding from about $.8 million to more than $2.2 million. About 30 per cent of its employees are engineers, technologists and technicians who work in R and D, more specifically in the design and development of new products and in the testing and quality control of finished products. The focus of Mitel's R and D endeavours is the application of the latest electronic technologies in product development rather

than basic research on new technologies. Current activities fall into four main areas: new telecommunications products; redesign of existing products to reduce costs, improve performance or simplify production; development of thick film hybrids to replace large electronic components; and design of LSI and VLSI chips for telecommunications equipment applications. Certain of Mitel's R and D projects receive support under programs administered by the National Research Council and the Enterprise Development Board's Electronics Panel of the federal Department of Industry, Trade and Commerce.

GENERALISTS

A few of the smaller communications equipment manufacturers are moving energetically on so many technological fronts that they are difficult to classify. Two of the most significant are Leigh Instruments and SED Systems which are both Canadian owned and controlled and which expend a considerable proportion of their revenues on R and D. Their success depends on their ability to manufacture a wide variety of special purpose products at the leading edge of technology which, because of the relatively small demand, do not invite the interest of the larger manufacturers.

Leigh Instruments

Leigh is headquartered in Ottawa and employs 1,500 people at eight branches in Ontario, Quebec, the United States and Ireland. The company designs, develops and manufactures a wide range of industrial electronics systems in its three main divisions: avionics, frequency control and industrial

products and security. Its 1979 total sales revenues amounted to $45 million of which about 22 per cent came from communications.

Two thirds of Leigh's sales revenues are generated by its industrial products division with plants in Waterloo, Ont., Syracuse, New York, and Ireland. The division manufactures some communications related products, such as the opto-mechanical security systems produced in Ireland and the electro-mechanical teleprinters made in Syracuse. In Waterloo, it manufactures office and industrial equipment employing optical character recognition (including mail sorters and printers) and various audio products.

Leigh's avionics division produces flight recorders, crash locators, traffic control systems and navigational displays, while its frequency control division manufactures oscillators, filters, calibration products and small printed circuit boards.

In 1979, Leigh spent approximately five per cent of its revenues on product development and improvement. These R and D activities included work on medical monitoring systems, a dual frequency beacon crash indicator, an ice detector for helicopter blades, photogrammetry systems for TV cameras and industrial robot sensing mechanisms. Leigh's optical sensing devices could have wide ranging applications in communications.

SED Systems

The Saskatoon company SED is a high technology engineering firm which is an offshoot of the space engineering division of the University of Saskatchewan. Incorporated in 1972, the company constitutes a rare example of a Canadian university research unit evolving into a commercially successful business venture. The company has grown at an annual rate of more than 35 per cent. Its annual sales are currently about $10 million.

SED employs 260 people and manufactures a remarkable assortment of products, ranging from aerospace to agricultural equipment. It has divided its operations into three principal areas: aerospace; communications; and instrumentation and control.

The aerospace division manufactures various products from specialized instruments for sounding rockets and high altitude balloons to special purpose payloads for space shots. The instrumentation and control division makes special instrumentation for use in agriculture and in industrial monitoring and control devices.

In the communications area, SED manufactures general telecommunications products and satellite earth stations. The general telecommunications products include automatic dialers, modems, rural communications subscriber systems and other units developed for ad hoc applications and not yet produced in large quantities. SED's involvement with earth stations started in 1970. The company has since become a supplier of fixed and transportable earth stations with associated components; its more significant products are television receiving terminals (TVROs) for use in remote areas.

SED devotes approximately five per cent of its sales revenues to the financing of its R and D activities.

CONCLUSION

This very diverse middle range of companies, which exported for an aggregate value of some $500 million in 1978, contributes significantly to the health of the Canadian economy. It also constitutes an important force for innovation as the firms that it encompasses put collectively more than $15 million into R and D in 1978. Yet the dominant impression garnered in an examination of this segment of the communications equipment industry is one of overwhelming diversity in terms of product lines, business strategy and economic viability.

The activities of the wire and cable companies appear to have levelled off because of fluctuations in world copper prices, slack in construction and chronic overcapacity. Because wire and cable is a mature technology, not much has been spent by these firms on R and D of late but the emergence of optical fibre as a commercially viable alternative to copper in certain communications applications is forcing some of them down a more innovative path.

The producers of mobile radios also experienced fairly static market conditions and spent relatively little on R and D in the last few years, but for a different reason. Congestion of the off-air radio frequency spectrum, especially in urban areas, has limited the market for mobile radio systems and technology imported from the United States has met existing requirements. Recently, the federal Department of Communications allocated more of the

spectrum to mobile radio use, a change which may broaden the market and arouse domestic interest in the search for new products.

In contrast, considerable ferment exists among manufacturers of radio and space transmission equipment and manufacturers of terminal-related equipment for telecommunications and data communications. Some of the companies involved are spending significant proportions of their sales revenues on R and D. Companies such as Spar, Gandalf and Mitel were created to exploit the technologies involved. Their basic strategy involves specialization in selected areas and establishment of strong beachheads in carefully chosen segments of the market where the lead they have established puts them well ahead of the competition.

But product specialization is not the only road to success as the experience of SED demonstrates. With careful planning and expert staff, a firm can manufacture a wide range of products embodying the latest technology and still maintain a profitable lead over potential competitors. In such cases, the firm usually makes special-purpose products which sell in low volumes and are thus of less interest to large multinationals.

Chapter 5

THE SPAWNING GROUND

Many small firms with annual sales of less than $10 million in 1978 have found a niche in the highly competitive business of communications equipment manufacturing. Sixty-four of the better known companies of this size were contacted for purposes of this study. Fourty-five of them are located in Ontario (Table 5-1). Most (some 75%) are Canadian owned and controlled.

These firms are not insignificant in the total communications equipment picture. They perform a vital role, manufacturing specialized final products and/or supplying necessary components to the larger Canadian communications equipment manufacturers and the electronics industry as a whole. Their average revenue in 1978 was $2.6 million. Their aggregate revenues for the same year came to $164 million or an amount slightly in excess of that derived by AEL Microtel during the same period. Most of them are fairly stable family firms which have been in existence for an average of 18 years. On average, each firm employs 85 people.

For the most part, these firms produce components such as connectors, resistors, power supplies, quartz crystals, converters, circuit boards, antennas, audio amplifiers, etc. Some of them have reached a state of technological and manufacturing development that enables them to produce final products in specialized areas such as radio systems (International Systcoms of Montreal and Glenayre Electronics of Vancouver), aerospace systems (MacDonald, Dettwiler and Associates of Richmond, B.C.), video (Volker-Craig of

Table 5-1

Geographic distribution of selected firms

with 1978 sales below $10 million

No. of companies	Location	No. of employees
11	British Columbia	416
0	Prairies	
	Ontario	
29	- Toronto-Hamilton	1,869
6	- Ottawa	268
10	- Rest of Ontario	1,895
8	Quebec and Atlantic Provinces	1,018
64	Total	5,466

Waterloo) and videotex (Norpak of Pakenham). A few companies perform custom design work, as does Linear Technology Inc. of Burlington, Ontario, which has annual sales of about $3 million and includes among its products linear LSI circuits. Summary descriptions of these six firms are provided in Appendix B to this chapter.

These small businesses have succeeded in penetrating foreign markets, with exports accounting for about 34% of their 1978 sales (table 5-2). Size does not seem to be an important factor in this success; firms earning less than $2 million a year have almost the same ratio of exports to sales as those earning between $5 and $10 million.

Individually these firms can appear insignificant. Yet they play an important role as suppliers to larger manufacturers of telecommunications equipment. The 37 firms earning less than $2 million a year employed on average only 41 persons in 1978. Yet the total group of 64 firms provided over 5,400 jobs in that year.

Table 5-2

Sales, exports, imports and
employment of selected smaller firms
by size category (1978)

No. of firms		Sales ($million)	Exports (as % sales)	Imports (as % of sales)	Employment
Sales : $2 million					
37	Total	33.1			1533
	Avr.	0.9	32.1	22.7	41
Sales: $2 - $5 million					
16	Total	51.1			2308
	Avr.	3.2	34.0	21.3	144
Sales: $ 5 - $10 million					
11	Total	80.1			1625
	Avr.	7.3	35.3	5.9	148
Canadian total					
64	Total	164.3			5466
	Avr.	2.6	33.6	19.7	85

APPENDIX A

THE SMALL COMMUNICATIONS EQUIPMENT MANUFACTURERS SURVEYED FOR PURPOSES OF CHAPTER 5

Adaptive Microelectronics Ltd.
Anatek Electronics Ltd.
Audio Transformer Company
Auto-Vox Inc.

Barvic Services Ltd.
Beckman Instruments Inc. (Helipot Division)

Canadian Astronautics Ltd.
CETA Learning Systems
Challenger Electronics Ltd.
Challenger Electronics (a division of Challenger Equipment Ltd.)
Com Dev Ltd.
Crescent Controls Ltd.
Croven Ltd.
CTS of Canada Ltd.

Dale Electronic Canada Ltd.
Daniels Electronics Ltd.
Decca Austin Insulators
Dynamic Industries Inc.

EDAC Inc.
Electronic Craftsmen
Electro-Vox Industries Inc.
Epitek Electronics Ltd.

Ferritronics Ltd.
FMC of Canada Ltd. (Semi-Conductor Products Division)

Geleco Electronics Ltd.
Glenayre Electronics Ltd.
Goodwood Data Systems Ltd.
Graphico Precision (Division of Firan-Glendale Corporation)

Hamilton Engraving company Ltd.
Hammond Manufacturing Company Ltd.
Hermes Electronics Ltd.

Intercontinental Data Control Corp. Ltd.
International Systems Ltd.

Lazer-Tech Ltd.
LeBlanc & Royle Communications Towers Ltd.
Leecraft Industries Ltd.
Linear Technology Inc.

MacDonald, Dettwiler & Associates Ltd.
MA Electronics Canada Ltd.
McCurdy Radio Industries Ltd.
Microwave Technology
Muirhead Systems Ltd.
Multi-Vox Ltd.

National Electrolab Ltd.
Neosid (Canada) Ltd.
Norpak Ltd.

Omicron Data Systems
Optotek

Precision Electronics Components Ltd.
Pylon Electric Development Company Ltd.

Quindar Products ltd.

Racal (Canada) Ltd.
Rantech Electronics
Reliance Telecommunication Products Ltd.
Renfrew Electric Co. Ltd.
Research Industries Ltd.

Sinclair Radio Laboratories Ltd.
Spilsbury & Tindall ltd.
Staticon Ltd.

Tectrol, Inc.
Tele-Radio Systems Ltd.

Valcom Ltd.
Varian Associates of Canada Ltd.
Volker-Craig Ltd.

APPENDIX B

Summary Descriptions of Six Canadian Companies Covered in Chapter 5

1. International Systcoms

Headquartered in Montreal, the company until 1979 specialized in radio telephone equipment for use in mobile land vehicles and in dial radio telephone equipment for fixed remote locations. It also produced two-way mobile radio and portable radio systems. In 1979, it purchased Control Devices of Edmonton, Alta. and Memotec Services of Montreal, Que. which have since become International Systcoms divisions. Control Devices manufactures energy management, alarm monitoring and meter reading systems for connection to the public switched network. Memotec produces data communications equipment including a statistical multiplexor that allows the direct interface of computers with pack switching networks. International Systcoms has plants in Montreal, Brockville and Edmonton and currently employs 300 people. Its 1978 sale were less than $10 million. However its post 1978 acquisitions have combined with new opportunities in mobile radio to promise sales of more than $23 million in 1980.

2. Glenayre Electronics

This North Vancouver based firm is reputed for innovative products in radio-telephone communications. Its terminals and control heads have gained wide acceptance in America (particularly the United States and Mexico),

Australia and the Middle East. Its R&D efforts have been successful in generating features that have set standards for the industry. Of late, Glenayre has turned its attention to new radiotelephone applications such as its Vehicle Location and Identification (VLI) system which allows data transfer between moving vehicles and fixed wayside locations and its Automatic Car Identification (ACI) system which is designed primarily for railroad box car location and inventory control. The company employs some 130 people. Its 1978 sales were of the order of $2.5 million. It expects to come very close to the $10 million sales mark in 1980. 80% of its production is currently exported.

3. MacDonald, Dettwiler & Associates (MDA)

The Richmond, B.C. firm specializes in the design and production of digital electronic systems for air and space applications. It is a major international supplier of earth resource and meteorological satellite ground stations. It also produces flight operations system (flight planning, flight watch, runway analysis, and aircraft movement control) for the commercial aviation industry. More recently it has developed a synthetic aperture radar system for air borne and space borne monitoring of ground surface developments. The company employs some 170 people. Its sale approximated $8 million in 1978; they are currently in excess of $10 million. Nearly 80% of MDA's production is exported.

4. Volker-Craig

This Waterloo, Ont. firm designs, develops and manufacturers computer terminal products, especially video display terminals. Of late, it has moved into the office automation area with its "VC 100" product line which integrates videotex, data and communications features. The company also produces "teletape", a telex editing and tape producing system. It currently employs more than 100 people and exports 75% of its production to Europe and countries of the Pacific Rim.

5. Norpak

The company is located in Pakenham, Ont. It specializes in the design, development and production of information processing equipment and systems for scientific, industrial and commercial applications. It has, in recent years, become extensively involved in Canadian videotex developments including the design and manufacture of the first generation of TELIDON PDI (picture description instruction) decoders and IP (information provider) systems. It currently employs a staff of 75 and expects sales of $7 million in 1980.

6. Linear Technology

Located in Burlington, Ont., the company designs, develops and manufactures linear monolithic integrated circuits for miniaturized audio uses. It has

gained a worldwide reputation for design sophistication and product performance. Over 90% of its sales, which currently run to $3 million a year, are made to customers in the United States, Europe, India, Japan and Australia. Typically these customers include manufacturers of hearing aids and other specialized audio products as well as manufacturers of microphone amplifiers, communications helmets, wireless microphones and micro cassette tape recorders.

Chapter 6

THE FOREIGN PRESENCE

A number of foreign communications equipment multinationals own Canadian subsidiaries which tend to import from their parents the products which they sell in this country. These subsidiaries differ in the extent to which they depend on imported ware, as opposed to their own designed and manufactured products. This balance between importation and assembling/manufacturing in their product lines can have significant implications for their Canadian operations and their ability to compete with Canadian-based manufacturers of communications equipment.

PLANTRONICS CANADA

Plantronics Canada (Plantronics), the Canadian subsidiary of the U.S. Plantronics and also an affiliate of the U.S. Fredericks Electronics, had sales of $2 million in 1979. It employed 25 to 30 people, roughly half in assembling/manufacturing and the rest in marketing and office work. The company's three main lines were data products, CRT terminals and telex switching equipment.

About half of Plantronics' 1979 sales related to data products, primarily controllers for use in data terminals. The remainder pertained largely to interactive CRT terminals with data retrieval and storage capabilities. These terminals, imported from the United States with final

assembly performed in Canada, have been sold successfully by the American parent in South America and Europe, especially Denmark, for use in banks.

Plantronics also marketed the Eltex line of telex switching systems with a capacity of up to 4,000 lines. Sales of this product peaked in 1975 when CNCP purchased three systems for use in Vancouver, Montreal and Moncton and Teleglobe Canada purchased another for use in Montreal.

Plantronics closed its Canadian manufacturing operations in the fall of 1980. Plandata of Montreal now acts as the Canadian agent for the Fredericks product line previously handled by Plantronics (Data and telex switches and HF radio equipment).

L.M. Ericsson Limited

L.M. Ericsson Limited (Ericsson) is a wholly-owned subsidiary of the Swedish multinational, Telefonaktiebolaget L.M. Ericsson. In 1978, the Ericsson group reported sales of about $2 billion while employing 65,000 people around the world. It operated manufacturing plants in 24 countries and distribution points in 61.

The Canadian subsidiary is primarily a distributor having virtually no manufacturing capability and carrying out limited assembly or adaptive work on equipment that is largely imported. Its 1977 sales approximated $19 million, with half deriving from telecommunications equipment. Of the latter, 90 per

cent came from switching equipment, a product category that typically accounts for about 45 per cent of the Swedish parent's worldwide sales.

Though unassociated with any Canadian telephone company, Ericsson has sold to all of them in the last 30 years, essentially because its parent was a world leader in switching technology until the early 1960s, having pioneered crossbar switching in the 1930s. The North American revenues of the Ericsson group have, however, always been small and, since 1965, Ericsson's modest share of the Canadian switching equipment market has been steadily eroded by the technological breakthroughs of the country's domestic manufacturers. The Swedish Ericsson has lately been seeking new opportunities in North America and its recent announcement of a co-operative venture with Anaconda, the U.S. mining multinational, would seem to indicate a new direction for its Canadian subsidiary.

The Canadian Ericsson does not carry out R and D work. Its parent has its own considerable research organization in Sweden where it also employs a staff of 450 to conduct co-operative research with the Swedish Telecommunications Administration. A recent area of study is advanced electronic switching and digital transmission, including an AXE electronic switching system as part of a $60 million contract to modernize the Swedish telecommunications network. Through subsidiaries, the parent also carries out R and D in Australia and France.

PHILIPS ELECTRONICS LIMITED

Philips Electronics Limited (Philips) is a wholly-owned subsidiary of the Philips Lamp Holding Company, the Dutch multinational which is the second largest company engaged in manufacture of communications equipment in the world. The Canadian subsidiary, with sales of about $150 million in 1978, operates service branches in virtually every province and has plants in Ontario and Quebec. Philips employs about 2,200 people; one in three is engaged in manufacturing and one in fifteen in product development. Little communications equipment, however, is presently made in Canada; Philips domestic manufacturing activities tend to be centered on consumer products.

Philips markets a variety of communications products in Canada: a telephone answering device which responds to an outside call and captures the message for later recall; a computer-controlled message switching system; a private automatic branch exchange for about 200 lines; and a non-digital intercom system. It does not consider manufacturing the message-switching and PBX systems in this country because they are made to European specifications and the size of the Canadian market provides little incentive for their redesign and production to Canadian standards. It may, however, engage at one point in some production of radio pagers and video terminal equipment.

Philips' data system division offers memory storage devices, video peripheral equipment and small computer business systems which stand alone or operate on line to a host computer. In 1977, the company extended its reach in office automation by acquiring the Canadian and U.S. branches of MICOM Data Systems which manufacture the text-processing systems that are now exported to the European Economic Community. Philips' parent has exploited other

opportunities in data systems, pioneering the use of lasers as light sources for optical recording systems -- a logical area of interest, given the group's varied interests in data processing equipment.

PYE ELECTRONICS LTD.

Pye Electronics Ltd. (Pye), another Philips subsidiary through a British sub-parent, had sales of $6 million in 1979 and employs 80 persons, including a technical staff of 18 who carry out systems design and modifications on imported equipment at the firm's Montreal headquarters. The company specializes in mobile radio and offers a product line that is, at present, entirely of foreign design and manufacture.

Pye has been more successful in selling VHF than UHF mobile radios through its chain of sales and service offices in Vancouver, Montreal and the Maritimes and sales offices in Toronto, Calgary and Edmonton. Its major markets are the Maritimes and Alberta. The company sells a dispatch radio imported from the United Kingdom in the Atlantic provinces and mobile telephone radio (a 15 KHz VHF manual system) imported from the United States to Alberta Government Telephones.

Since its purchase by Philips in 1967, Pye has gradually been consolidated into the worldwide operations of its parent and has thus improved its position in export markets. The company currently makes 65 per cent of its sales in the United Kingdom; it has, however, made few inroads into the Canadian market which accounts for only five per cent of its sales.

Philips plans to establish a design and manufacturing facility for mobile radio in the United States, probably by buying an American firm. Pye may then import a far larger proportion of its products from this American subsidiary and, because these would be designed for the North American market, could increase its share in the Canadian market.

AEI TELECOMMUNICATIONS (CANADA) LTD.

AEI Telecommunications (Canada) Ltd. (AEI) is a subsidiary of the British multinational, General Electric Company, Ltd. which is the seventh largest firm engaged in the manufacture of communications equipment in the world. AEI was founded in 1924 when the provincially owned Manitoba Telephone System (MTS) was looking for another source of dial switching equipment. At that time, Automatic Electric (Canada) was the major manufacturer of such equipment and Northern Electric (later Northern Telecom) had only begun to manufacture dial exchange systems for Bell Canada. AEI, with 130 employees and sales of $9 million in 1979, still performs all its production, sales and marketing operations in Winnipeg. Roughly 50 per cent of its Canadian sales derive from products manufactured in Winnipeg and the rest from imported goods.

AEI's manufacturing activities include the assembly of printed circuit boards, some shelf and rack wiring, some sheet metal work and the final assembly of certain imported products. The firm also performs testing operations, such as systems tests at high temperatures to detect the possible early failure of semiconductors. It is less interested in custom or short-term manufacturing operations than in specialized systems which find a niche in the Canadian

marketplace. Its main manufactured products are telephone answering switchboards and ANIPAKs -- an automatic number identification system -- for toll facilities in central offices. For both these products, AEI carries out the related system design and manufacture, using relays and switching exchange systems imported from its British parent. Recently, AEI received a $1 million order from Thomson-CSF, the French multinational, for ANIPAKs to be installed in Jordan. The order may be the bright spot in an otherwise clouded picture for sales of these products have declined steadily since 1970. The company signed an agreement with Nippon Electric in 1970 under which it received the right to distribute and sell the Japanese multinational's PBXs and central office switching equipment in Canada. The agreement covered the current electronic/digital designs of these products. At present, Nippon's PBXs are AEI's major imported products. The company, however, is trying to reduce its dependence on foreign sourcing and claims that it is developing certain products which may find a niche in the Canadian market.

Siemens Electric Ltd.

Siemens Electric Ltd. (Siemens) is a subsidiary of the German multinational, Siemens AG, the third largest company engaged in the manufacture of communications equipment in the world. In 1979, Siemens employed 400 people and had sales of $80 million -- double its level of the previous year.

In 1979, 62 per cent of Siemens' sales derived from, and some three-quarters of the company's employees worked in, areas only peripherally related to communications. A medical engineering division markets equipment for radiology, electromedicine, dentistry and electro- acoustics. A power

engineering division produces heavy electrical and industrial equipment for use by light rail vehicles, power utilities and the bulk conveyor systems used by Syncrude in Alberta.

1979 sales of telecommunications equipment approximated $30 million and accounted for some 38 per cent of the company's revenues. The products involved were turned out by the electronics division which employs 100 people or one-quarter of the company's work force. The division does sheet metal work, assembles electrical control panels, performs drafting and engineering work on power equipment, and has its warehouses and headquarters in Pointe Claire, Quebec.

The electronics division has three main product areas: components; data and information systems; and telecommunications equipment and telegraph and signalling systems. Canadian sales of components, mostly passive components imported from Siemens plants abroad and sold to other manufacturers in this country came to $12 million in 1979. The division sold some $3 million worth of data and information systems in the same year. The division's 1979 sales of telecommunications equipment and telegraph and signalling systems were its largest, the revenue generated amounting to $15 million. Its signalling systems were sold mainly to railways such as the Edmonton rapid transit system. Its telecommunications equipment which include teleprinters and telex switching equipment and a private branch exchange (PBX) were sold to some of the principal Canadian telecommunications carriers. The division has recently completed arrangements to commence production of the company's popular SD 192 PBX designed by another Siemens subsidiary in the United States.

The parent company seems to recognize that products of European design experience marketing difficulties in North America because of their incompatibility with indigeneous equipment. It is eager to make headway in the world's largest telecommunications market and has actively engaged in the establishment of design and manufacturing facilities in the United States. It is currently proceeding with the design of a new central office with the capability of handling 10,000 lines in that country. Its Canadian subsidiary would be willing to establish design and manufacturing facilities in this country if the market justified it.

ITT CANADA LIMITED

ITT Canada Limited (ITT) is wholly owned by the American multinational, International Telephone and Telegraph Corporation, one of the largest companies engaged in the manufacture of communications equipment in the world. The Canadian subsidiary's 1978 sales amounted to $540 million of which 45 per cent came from its natural resource materials division (principally sales of wood products), 40 per cent from its industrial engineering products division, six percent from its consumer products division and 4.5 per cent ($25 million), from its communications and electronics division. Communications sales in Canada were below average for the international ITT family.

The communications division increased its staff from 375 to 500 in 1977. It currently operates three manufacturing plants of which the largest employs over 300 people at Guelph, Ontario. Its other plants in Winnipeg and

Regina each have about 75 employees. Seventy of its employees are engaged in development work on new communications systems.

The division's main products are: key systems, telephone sets, private branch exchange (PBX), electronic switches, line cards for use in central offices and postal automation systems. Its key systems, originally of U.S. design, have been modified for the Canadian market; the company developed, at Guelph, an electronic version of these units (MKS-100) which it currently markets in the United States. Its 3100 PBX was also developed at Guelph where it is produced for sale in the Canadian market.

In 1974, ITT designed its DM32S, a subscriber multiplex system capable of concentrating 128 telephone connections on two pairs of wires. The company is striving to penetrate the U.S. market with this product in competition with Northern Telecom's DMS-1. It is seeking sales from independent U.S. telephone companies and has won approval from the U.S. Rural Electrification Authority for the equipment.

Another product which used to be sold by ITT is the "Metaconta L", a U.S. designed electronic switch capable of handling 34,000 lines. The company installed one of these switches in Calgary, Alta.

The company was also the prime contractor for the production and installation of automated postal equipment for the Canadian Post Office. It is now seeking sales abroad for this equipment.

PLESSEY CANADA

Plessey Canada Limited (Plessey) is a wholly-owned subsidiary of the British multinational, Plessey Company, which has branches in 32 countries. The Canadian subsidiary came into being in 1962 and, until three years ago, imported and distributed telecommunications products manufactured in the United Kingdom, principally public telephone exchange equipment. The equipment was used mainly to maintain or extend existing plant in Ontario and Quebec, especially in rural areas. The emergence of wholly electronic exchanges is rapidly rendering such electromechanical equipment obsolete.

The company set up its own R and D and manufacturing facilities in 1977 and now exports products and services to its British parent and to the United States. Sales almost doubled between 1977 and 1978 to reach some $9 million. Corporate employment is expected to grow by 50 per cent over the next few years to more than 200. The firm derives 90 per cent of its revenues from sales of communications products of which two thirds relates to exports and the remainder to sales of radar and communications equipment to the Canadian military.

One of the principal products designed and developed by Plessey is a solid state four-wire private automatic exchange for 100 lines which is capable of monitoring users' calling patterns and costs. Production began in 1977 and had quadrupled to 100 units by 1979. Despite competition from Northern Telecom, AEL Microtel, Mitel, Siemens, ITT, ATC and Tel Resources (the last two being U.S.-based firms), Plessey has had some sales success with this equipment, principally in the U.S. where most of its 1979 production has gone. Plessey

Brazil now intends to manufacture the equipment under licence. Plessey also designed and developed a key system with PBX features, the K-1, of which it sold several hundred in Canada and the United States.

Other products manufactured by Plessey include solid-state "ring and tip" equipment used by carriers to replace older party-line sharing equipment in public telephone exchanges. Plessey Peripheral Systems in Mississauga, Ontario -- a subsidiary of the Canadian company -- also produces microprocessors and minicomputer systems for small business applications, as well as the accompanying peripheral devices, printers, terminals, storage devices and converters.

Roughly one out of every 10 Plessey employees works on R and D, an area to which the company has thus far committed about $2 million. Clearly state-of-the-art technology is seen as essential to the corporate effort to penetrate foreign markets.

CONCLUSIONS

The subsidiaries of multinational communications equipment firms differ widely in their reliance on imported products. Companies such as Ericsson and Philips are very dependent on products obtained from their parents, while others, such as ITT and Plessey, tend to carry out significant manufacturing and R and D in Canada.

Interestingly, the companies dependent on imported products seem to be less successful than those manufacturing in Canada. For the subsidiaries of European parents, one difficulty is the diminishing acceptance of European designs in the North American communications market. Some of the European parents are now increasingly using their American subidiaries to design and manufacture products for the North American market. While imports may not presently constitute a serious threat to Canadian manufacturers, there may be reason for concern if overseas multinationals continue to establish manufacturing facilities in the United States.

Chapter 7

THE WORLD SCENE

Northern Telecom is as small on the world communications equipment scene as it is eminent in the Canadian market. Several of its large foreign competitors are also active in Canada where, as was seen in the previous chapter, they show their corporate flags in a variety of ways and with varying degrees of success. Competition in the world communications equipment market is growing more intense at a time when access to these markets is getting increasingly more vital to the survival and prosperity of progressive Canadian firms. These firms must reach beyond the boundaries of the limited domestic market to recover the expenditures they incur in maintaining their technological edge. The present chapter focuses on the international leaders of communications equipment manufacturing in an attempt to provide as complete a backdrop as possible to the environment confronting Canadian manufacturers of these products. The 13 firms involved, including Northern Telecom, all have annual sales of more than $1 billion and operate on a global scale. As can be seen in Table 7-1, Northern is the smallest member of this "billion dollar club" of communications equipment manufacturers. The total sales of the largest, the U.S. International Telephone and Telegraph (ITT), amounted to US $19.4 billion in 1978; the comparable figure for Northern was CAN $1.5 billion. In terms of sales of communications products, Western Electric, another American firm was the largest, with sales of US $9.5 billion. Its sales were roughly double those of its closest rivals -- ITT, and Philips. The remaining companies are only half as large again, with sales ranging from $1 billion to $2 billion annually.

Three of these firms -- Western Electric, Ericsson and Northern Telecom -- produce only communications equipment and related products. The others manufacture communications as well as other electronic products and do not always distinguish among products in their finanical reporting. Because of this, the data provided on their activities in Table 7-2 and elsewhere in this chapter must be treated with circumspection as they are not always fully comparable among firms.

All 13 companies are based in industrialized countries. Four are from the United States. Two are from Japan and two more are from France. Holland, Sweden, West Germany, the United Kingdom and Canada have one each.

Table 7-1

World Communications Equipment Manufacturers with 1978 sales* of Communications Equipment exceeding $1 billion

	Manufacturer (in order of total sales)	Total sales ($billion)		Communications equipment sales ($billion)		Total number of employees	Base Country
1.	International Telephone & Telegraph	US	19.4	US	4.7	379,000	US
2.	Philips Lamp Holding Company	C	17.3	C	4.4	387,900	Holland
3.	Siemens AG	C	16.5	C	3.1	322,000	FRG
4.	Hitachi *	US	10.8	US	1.8	138,700	Japan
5.	Western Electric	US	9.5	US	9.5	161,000	US
6.	General Telephone & Electronics	US	8.7	US	1.8	214,000	US
7.	Rockwell International	US	5.7	US	1.3	114,200	US
8.	General Electric Company (UK)	C	5.5	C	2.1(E)	178,600	UK
9.	Cie Générale d'Électricité	C	5.2	C	1.4	104,900	France
10.	Thomson-Brandt*	C	4.3	C	2.2	109,200	France
11.	Nippon Electric Company	US	3.7	US	1.4	60,500	Japan
12.	L.M. Ericsson	US	2.1	US	2.1	61,400	Sweden
13.	Northern Telecom	C	1.5	C	1.5	31,000	Canada

* 1977 data for Hitachi and Thomson-Brandt; 1978 data for all other companies

(E) Estimates. General Electric (UK) does not report net product group sales or intra-company sales.

+The Canadian and U.S. company sales are quoted in the dollar currency reported. The sales of overseas companies are converted to Canadian dollars at the average exchange rate for 1977 or 1978, except for Nippon, Hitachi and Ericsson which report in US dollars.

SOURCE: Company Annual Reports

INTERNATIONAL TELEPHONE AND TELEGRAPH (ITT)

ITT, the largest company involved in communications equipment manufacturing in the world had a total 1978 sales of US $19.4 billion. Among world corporations, ITT stood 13th in terms of 1978 revenues, being surpassed only by General Motors, the Ford Motor Company, International Business Machines, U.S. General Electric, American Telephone and Telegraph and the seven major oil companies. ITT operates in 80 countries and is a diversified, multinational conglomerate with manufacturing operations in communications, semiconductors, defence and avionic systems, automotive and industrial products, food products and consumer appliances. The company also has service operations in communications, hotels, insurance and finance, as well as a resource industry based on wood, coal, oil and natural gas.

Through ITT World Communications Inc. and other subsidiaries, ITT provides international telegraph, telex and other recorded message services between the U.S. and several foreign countries. The company also supplies international telephone services in Indonesia, Puerto Rico, the Virgin Islands, Bolivia and the Panama Canal zone, as well as domestic voice and data services in the U.S. and Virgin Islands. Its revenues from communications services came to US $265 million in 1978.

ITT also manufactures a complete range of telecommunications equipment in such areas as switching, transmission, station apparatus and outside plant, as well as transoceanic submarine cable. Its activities in this area are concentrated in five European subsidiaries: Bell Telephone Manufacturing

Company in Belgium; Standard Elektrick Lorenz A.G. in West Germany; Compagnie générale de construction téléphonique in France; Standard Electrica S.A. in Spain; and Standard Telephones and Cables Limited in the U.K. ITT operates smaller communications manufacturing subsidiaries in several other European nations, Latin America, the U.S. and Australia.

The company carries out R and D in the laboratory and engineering facilities of most of its manufacturing subsidiaries, as well as within its major research centres in the United States, Belgium, France, Germany, the U.K., Italy and Spain. Its 1978 R and D expenditures amounted to US $799 million, including contract work for customers. ITT performs R and D in all areas of communications, including opto-electronics and semiconductors.

PHILIPS LAMP HOLDING COMPANY

Philips, a Dutch multinational, had total sales of $17.3 billion in 1978. The company's sales of "products and systems for professional applications", a category which includes communications equipment, came to $4.4 billion or almost three times Northern Telecom's sales.

Philips is the largest European electrical and electronics manufacturer. It tends to specialize in consumer goods (domestic appliances and home entertainment products) which account for about 60 per cent of its total sales. The company also manufactures lighting, medical and communications equipment as well as electronic components, pharmaceuticals and fertilizers.

Europe constitutes Philips' major market and generates some 63 per cent of its total sales. North America, which accounts for 17 per cent of the company's total sales, is its next largest market. Latin America, Africa, Asia, Australia and New Zealand are its other principal areas of business activities. Philips has subsidiaries and affiliated companies in more than 60 countries.

Philips manufactures a wide variety of telecommunications and computer communications equipment, including mobile radio, telex switching, broadcasting equipment and data and text processing systems and terminals. The company and the Swedish multinational, Ericsson began, in 1978, to supply telephone switching equipment for 476,000 lines to Saudi Arabia as part of a $2.5 billion contract to modernize and expand the telephone system of that country.

A recent report[1] indicates that Philips is the leading semiconductor manufacturer in Europe, supplying 19 percent of that market[2] with the help of its U.S. subsidiaries. The company claims to be next to Texas Instruments in worldwide semiconductor sales.

Philips carries out considerable R and D in communications. The company is currently working on experimental glass fibre communications systems. It is also conducting research on disk storage systems with optical recordings and readout, as well as doing developmental work on large scale integration, including such applications as a digital/analog converter.

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1 Mackintosh Report, as described in the Financial Times of London, October 16, 1979.

2 Motorola, in the Financial Times of London, November 19, 1979, estimates the size of Western Europe semiconductor market at $US 3.0 billion in 1980, and the world market at $US 11.5 billion.

SIEMENS AG

Founded in 1847, the West German firm of Siemens AG is one of the oldest members of the international electrical and electronics industry. A major portion of its business is associated with heavy electrical and power generating equipment but its communications and electronics business is growing rapidly. The company sold $3.1 billion worth of communications equipment in 1978 or more than twice as much as Northern Telecom. Siemens equipment is manufactured in 73 factories at home and abroad and is marketed in 112 countries. Fifty per cent of its market lies outside West Germany.

Siemens' electronics products include semiconductors, computers and peripherals, as well as medical and dental equipment. These accounted for eight percent of the company's total sales in 1978. Siemens has aggressively pursued new technologies in this area through in-house development and joint ventures with foreign firms. In order to improve its position in data processing systems, the company has concluded an agreement with Fujitsu, a Japanese firm, to exchange products and technical information so that the Fujitsu computers and Siemens peripherals can complement each other. It has also concluded agreements with U.S. firms relative to semiconductor developments.

Communications equipment was responsible for 19 per cent of Siemens' total sales in 1978. The company is the major supplier for the Bundespost (the German post office) of switching, transmission and terminal equipment used in the German telecommunications network. In recognition of the importance of product engineering and manufacturing close to the market, Siemens has

established 20 local plants, which handle one half of its international business in communications. Recently, the company entered the North American market for private branch exhanges with equipment designed and manufactured by its U.S. subsidiary.

Siemens is heavily committed to R and D, spending $1.3 billion to that end in 1978. This was nearly 13 per cent of the total expended on R and D by all West German industry that year (excluding industry R&D funded by government) in areas of national interest such as micro-electronics and data processing. Some 45 per cent of Siemens' total sales derive from products introduced in the past five years.

HITACHI

Hitachi, the Japanese multinational, had total sales of US $10.8 billion and sold US $1.8 billion of "communications and electronics equipment, and measuring instruments" in its 1978 financial period. The firm is a major supplier of telecommunications switching equipment and facsimile and data terminals to the Nippon Telegraph and Telephone Company, the domestic telecommunications carrier owned by the Japanese government.

Hitachi also manufactures heavy electrical equipment, industrial machinery, consumer products (appliances and home entertainment), railway rolling stock, chemicals, special steels and automotive parts and accessories. It has overseas production facilities in Brazil, Costa Rica, Malaysia, Singapore, Taiwan and the United States. It is currently expanding its overseas production to get around the restrictions placed on imports and to accommodate

the priority attached to job creation by governments abroad. The company exports only about 20 per cent of the products it manufactures in Japan.

Hitachi's R and D expenditures of US $364 million in 1978 were concentrated in energy conservation and electronics. In the electronics area, the company has developed a high density optical video disc employing a new type of laser and featuring a storage capacity of 10 billion bits, as well as a prototype television set with a liquid crystal display. Its ultimate objective is to develop computers of international reputation through exports and exchanges of technology.

WESTERN ELECTRIC

Western Electric is the world's leading manufacturer of communications equipment. Its major customer is the U.S. Bell System which accounted for 94 per cent of its 1978 sales of US $9.5 billion. Western is wholly-owned by the American Telephone and Telegraph Company (AT&T). The parent and its manufacturing subsidiary each hold a 50 per cent interest in Bell Telephone Laboratories, the research arm of the Bell System.

Western manufactures a complete line of telecommunications equipment. A wholly-owned subsidiary, Teletype Corporation, makes teletypewriters and certain types of data terminals. After an absence of several years, Western re-entered the international communications business in 1978, establishing a subsidiary, Western Electric International Inc. The new firm is the prime contractor for a US $500 million microwave system in Saudi Arabia.

R and D expenditures by Western Electric came to US $528 million in 1978, including intramural manufacturing and product development as well as contributions to Bell Telephone Laboratories. The company also performed research on contract in such areas as solar energy, fusion energy, ordinance and nuclear weapons through the Sandia Corporation, a non-profit organization.

GENERAL TELEPHONE AND ELECTRONICS

In 1978, GTE had total sales US $8.7 billion and communications sales of US $1.8 billion. The company operates both as a carrier and a manufacturer, deriving about equal revenues from each sphere of activity.

As a carrier, GTE operates the largest non-Bell system in the U.S. and, with 14 million telephones in service, has a market comparable in size to the entire Canadian telephone market. The firm operates a further 2 million telephones in British Columbia, Quebec and the Dominican Republic.

As a manufacturer, GTE offers a wide range of products in telecommunications, electrical power, and components for the electrical and electronics industry. The company operates 96 plants in the U.S. and 55 in Canada, Europe, Latin America, the Caribbean, the Far East and Australia. It is also involved in associated manufacturing arrangements in Italy, Mexico, Japan and the Philippines.

The company's largest single product area is telecommunications. It manufactures a complete line of switching, transmission and terminal equipment and sold 49 per cent of the related output to its affiliated telephone companies in 1978. Defence and aerospace systems also account for an important part of

its activities in this area. The company's sales of telecommunications equipment to its telephone subsidiaries in the United States are reflecting since 1979 the Consent Agreement negotiated as a result of the Hawain Telephone Company case. The agreement compels the GTE telephone subsidiaries to use competitive bidding in their procurement endeavours.

GTE is active in export markets and achieved its greatest success when it won a US $500 million contract to install electronic switching equipment in Iran. The company had shipped about 46 per cent of the ordered 670,000 lines by the end of 1978 when work stopped because of the unsettled political situation in that country.

In 1978, GTE spent US $127 million on R and D and employed 2,200 technical personnel mostly at GTE Laboratories Incorporated and GTE Automatic Electric Laboratories Incorporated in the United States. The company's R and D program focuses on digital switching, laser diodes, solar panels and studies of rain attenuation in high frequency satellite transmission. It has also installed experimental optical systems in Canada, Belgium and the United States.

ROCKWELL INTERNATIONAL

Rockwell, an American multinational with manufacturing facilities in the U.S. and 10 other countries, had total revenues of US $5.7 billion in 1978 from roughly equal sales of automotive components, aerospace, electronics and "general industries" -- the firm's four main product areas. "General industries" comprise printing presses and textile machinery, consumer products

(tools and appliances) and equipment for the oil, gas and nuclear industries. The company's aerospace division is well known for its role in the Apollo and space shuttle programs.

Sales of the company's electronics products, including avionics, defence systems, semiconductor devices and commercial communications equipment, came to $US 1.3 billion during that year. The Rockwell-Collins division, created from a merger with the former Collins Radio Company, manufactures most of the communications products. Rockwell has sold its automatic call distributor to five airlines and provides the microwave radio for the Western Electric contract with Saudi Arabia. The Public Broadcasting System recently purchased 160 Rockwell television earth stations and the National Public Order System has ordered some Rockwell earth stations for the initial phase of its project to create a network of 192 earth stations. The company also manufactures and sells automated funds transfer systems for banking.

In 1978, Rockwell spent US $1.4 billion on R and D, mostly under government contracts for the space shuttle and other aerospace programs. R and D initiated by the company itself amounted to US $24 million.

GENERAL ELECTRIC COMPANY (GEC)

In 1978, GEC, a British multinational, had total sales of $5.5 billion. "Electronics, automation and telecommunications" products accounted for $2.1 billion in sales. The company presently derives more than 50 per cent of its total revenues from the electrical side of its business which includes power station equipment, industrial machinery, wire and cable, lighting and home

appliances. The firm has more than 100 subsidiaries situated primarily in the U.K. where 80 per cent of its manufacturing takes place. The company also operates overseas plants in 20 countries in Europe, North America, Australia and Asia.

To a large degree, the company's presence in the communications area arises from its 1968 merger with the English Electric Company and Associated Electrical Industries (AEI) which brought to GEC the Marconi and AEI product lines. GEC is now one of three major suppliers for the British Post Office (BPO), to which it offers a full range of switching, transmission and terminal products. The first "System X" units, new electronic switches developed under a BPO/industry program, are now going into production. The company has also played a leading role in developing the Prestel videotex system.

GEC has commenced R and D on large scale integration, solid state imaging, digital television, optical transmission, radar and a new generation of telephone sets. The company recently received a contract for the first long-distance optical transmission system in the U.K., which would operate between London and Banbury at speeds of up to 140 megabits per second.

COMPAGNIE GENERALE D'ELECTRICITE AND CIT-ALCATEL

The Compagnie générale d'électricité, a French multinational with total sales of $5.2 billion in 1978, is heavily involved in the electrical and

electronics business but also conducts a large general contracting and consulting business, mainly in the construction of buildings, dams, tunnels, harbors, highways and airports for government. The company has more than 60 subsidiaries and is growing rapidly; 19 of its subsidiaries were acquired or created in 1978. It also owns a 20 per cent share of Honeywell-Bull, a computer manufacturer with annual sales of more than $1 billion.

The firm's communications business is conducted by two groups of subsidiaries headed by Les Câbles de Lyon and CIT-Alcatel, respectively. Together, the two groups had sales of roughly $1.4 billion in 1978, producing 27 per cent of the telecommunications equipment sold in the French domestic market, (second only to Thomson-CSF). Foreign sales accounted for $250 million of that amount.

Les Câbles de Lyon manufactures power and telecommunications cables for all applications, including transoceanic telephone service and optical transmission. CIT-Alcatel is more diversified, producing communications equipment, electronic office systems, and postal automation equipment and providing data processing services. The parent company is a leading manufacturer of telecommunications transmission and switching equipment and is known particularly for its E10 digital switcher which has been sold in 14 countries.

The Compagnie générale d'électricité does not report R and D expenditures; however, its export successes and its major role in the modernization of the French telecommunications network indicate no deficiency in this regard.

THOMSON-BRANDT AND THOMSON-CSF

Thomson-Brandt, another French multinational, had total sales of $4.3 billion in 1977. It is an organization of 100 companies whose major interests are consumer goods and "professional electronics". The latter category, representing sales of $2.2 billion or almost one half of the total, is vested with the Thomson-CSF group of companies. In addition, Thomson-CSF manufactures and sells equipment for avionics, sonar detection systems, air traffic control systems, nuclear power plant simulators, and weapons systems. It also manufactures semiconductors and computers and provides computer services. It sells its products and offers its services in over 90 countries. Foreign sales accounted for 44 per cent of its total sales in 1977. For the Thomson-Brandt group as a whole, foreign sales accounted for 55 per cent of total sales in 1977.

The French telecommunications manufacturing industry was completely re-organized in 1976 and since that time French-owned firms have supplied 85 per cent of the domestic production. Thomson-CSF participated in this re-organization by acquiring a controlling interest in Le Matériel Téléphonique (LMT) and Société française des téléphones Ericsson, both manufacturers of switching equipment. These former ITT and LME subsidiaries were merged to form Thomson-CSF Telephone, giving the group the strong switching capability which it had previously lacked. Thompson-CSF Telephone has joined CIT-Alcatel as a major supplier of switching equipment to the French PTT. As a result of these developments, the Thomson-CSF Group is now the largest manufacturer of telecommunications equipment in France, currently accounting for more than 30 per cent of the national production in this area.

Thomson-CSF does not report its R and D expenditures. The group has a central laboratory conducting research in physics and chemistry. It owns a semiconductor subsidiary which focuses on charge-coupled devices, opto-electronics and custom large scale integration. It was recently contemplating a joint semiconductor venture with U.S. Motorola. It is also well known for its technological achievements in microwave radio and it supplies 14 GHz equipment for the European Communications Satellite System and the U.S. Tracking and Data Relay Satellite System.

NIPPON ELECTRIC COMPANY (NEC)

NEC, a Japanese multinational first incorporated in 1899 as a joint venture with Western Electric, has since become a major world scale manufacturer in its own right, producing a comprehensive range of telecommunications equipment which accounted for 38 per cent of its total sales of $3.7 billion in 1978. Data processing and industrial systems earned another 22 per cent while electronic devices, consumer electronics, and avionics test equipment accounted for 17, 11 and 12 per cent, respectively, of its proceeds from sales in that same year.

NEC's telecommunications products include satellite earth stations (the company is a major supplier of INTELSAT stations), submarine cable repeaters, optical fibre systems and 800 MHz cellular radio for mobile telephone services. It has manufacturing facilities in Japan, Australia, Brazil, Iran, Ireland, South Korea, Malaysia, Mexico, Singapore, Taiwan and the U.S. and sells its products in 120 countries around the world. Its major market remains Japan which takes up some 75 per cent of its overall production.

NEC is heavily committed to R and D; it spent US $145 million and employed 4,000 technical personnel in this area in 1978. Its endeavours are focused on telecommunications, computers and semiconductors and on the interaction between these technologies. In recent years, it developed a high-power gallium arsenide FET amplifier for terrestrial and satellite microwave radio; semiconductor lasers for facsimile, video disc players and optical communications systems; a charge-coupled device for use as an image sensor for facsimile and optical character readers; and improved computer languages and automation systems for integrated circuit design.

L.M. Ericsson (LME)

LME, a Swedish multinational founded in 1876, is a leader in the world communications manufacturing industry and is active in some 100 countries around the globe. The company produces a complete line of telecommunications equipment which generated sales of US $2.1 billion in 1978. It developed the crossbar switch before the Second World War and derived major benefits from its production and distribution in Europe and other parts of the world until the advent of the electronic switches of the early 1960's.

LME's main activities take place in Sweden where approximately 55 per cent of its manufacturing employees are located and where much of its R and D takes place. Outside Sweden, the company manufactures primarily in Europe and Latin America. About US $900 million or 86 per cent of its 1978 sales was derived from exports. Its fastest growing foreign market is Asia where it shares a Saudi Arabian contract with Philips of the Netherlands. LME has failed to achieve a significant presence in North America.

LME has a heavy commitment to R and D, spending US $174 million in this area during 1978. Part of this expenditure (estimated at $10 million to $15 million) went to ELLEMTEL, a research company which it owns on a 50/50 basis with the Swedish Telecommunications Administration. It also has a semiconductor research and manufacturing subsidiary in AB Rifa which specializes in custom products required by its parent and other customers. The company sometimes assigns product development or modification to meet local requirements to its subsidiaries and affiliates abroad.

THE WORLD TELECOMMUNICATIONS MARKET

According to a recent estimate, the world market for telecommunications equipment stands at US $40 billion in 1980. It is currently growing at an estimated eight and a half per cent a year and it will likely reach US $87 billion by 1990.[3].

North America will remain the largest market but its relative importance will decline because of speedier growth in the Asian (U.S.S.R., Japan, Korea and China) and Middle Eastern markets. This trend is predictable because communications are less extensively developed outside North America and accelerated growth of national wealth will encourage rapid modernization of communications infrastructures in certain areas.

Though the growth of the world market will create opportunities for Canadian communications equipment manufacturers, serious obstacles to their success will have to be overcome. In developed countries, much of the

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3 Estimated by Arthur D. Little Inc., Cambridge, Mass. U.S.A.

communications equipment market is protected against foreign competition. Either Governments tend to favour domestic firms in their procurement policies or major domestic carriers favour manufacturers with whom they have intercorporate links. Too often, the foreign supplier has little chance unless he can enter into a joint venture or licensing agreement with a domestic producer. Legal and regulatory measures encouraging competition have made the American market the most accessible, but the foreign supplier must compete in that market with four of the largest manufacturers of communications equipment in the world. Though developing countries seem to offer real opportunities because of their generally less developed communications infrastructure, past colonial associations, tied-aid programs or the entrenched local presence of a foreign manufacturer frequently blocks entry.

For these reasons, only 20 per cent of the present world market for communications equipment appears to be open to competition. But 20 per cent of US $40 billion is large enough to attract firms which, with their vast resources, can provide vigorous competition.

Chapter 8

COMMENTARY

Perhaps the dominant impression that arises from this survey of Canadian communications equipment manufacturers is that of considerable diversity. The firms involved differ widely in size, product line, degree of specialization, level of R and D, volume of foreign sales and dependence on imported products.

Nevertheless comparisons can be made. As Figure 8-1 illustrates, Northern Telecom is the largest communications equipment manufacturer in Canada, and, in terms of total sales, is about 10 times greater than its rival, AEL Microtel. Smaller firms, however, are not insignificant in the aggregate picture. The 14 middle-sized firms -- those with annual revenues between $10 million and $100 million -- together earn about four times the revenues of AEL Microtel and more than one third those of Northern Telecom. Even the firms earning less than $10 million a year collectively made about $150 million in sales in 1978 or roughly as much as AEL Microtel. The subsidiaries of large foreign multinationals, many of which mainly sell products imported from their parents, had, as a group, communications equipment sales of more than $100 million in 1978.

Further one can postulate that there are parallels between the structure of the Canadian communications equipment manufacturing industry and that of the Canadian communications service industry. Northern Telecom outdistances the other manufacturers with the same ease as its parent, Bell

Canada, leads the other carriers. AEL Microtel holds the same position among the manufacturers as the British Columbia Telephone Company (B.C. Tel), its parent and the second largest carrier in the country, holds among the carriers. Indeed, Northern and AEL currently supply about 80 per cent of the Canadian market for telecommunications equipment, while their parents operate about 70 per cent of the telephones in service within the country. The remaining manufacturing firms have no formal links with the carriers.

THE LIMITS OF THE CANADIAN MARKET

All these manufacturers are currently competing for a share of a Canadian market estimated to be worth $2 billion. It is a market limited in size which imposes significant structural constraints on domestic manufacturers' activities.

Canada's federal system influences to some degree the market for communications equipment by giving the federal and provincial governments joint responsibility for industrial promotion and development. Provincial authorities take considerable interest in the manufacture of communications equipment within their boundaries because the industry generates skilled employment and spins off additional work to local businesses and industries. This interest finds its expression in a certain propensity by provincial governments to favour local manufacturers of telecommunications equipment thereby limiting the degree to which the entire Canadian market is accessible to domestic manufacturers. Only

very large manufacturers can establish themselves as "native sons" in different regions and gain an edge over many of their smaller counterparts, especially latecomers, into a regional market.

Even without this provincial benefit factor, many Canadian communications equipment manufacturers would be unable to appeal to our widely dispersed and diverse domestic market. It is a market hardly comparable in terms of demand to an equivalent share in the American market because the latter would generally be concentrated in a much smaller area and be more homogeneous with respect to needs. Only the central Canadian market exhibits characteristics similar to those of an average American market area in terms of demand for communications equipment and the modalities of supplying that demand. As it is, the Quebec-Ontario region is the biggest Canadian market area, currently containing about 62 percent of the country's telephones.

These structural constraints limit the number of entrepreneurs who can realistically hope to operate domestic manufacturing facilities for the purpose of serving the entire Canadian market. Competition between a number of manufacturers may be possible in certain urban parts of Ontario, Quebec, British Columbia and Alberta. Other less industrialized and populated regions are less able to support more than a few manufacturers. Purchasers in such areas generally minimize installation and service costs through reliance on products of assured availability and guaranteed service. Provincial industrial initiatives only reinforce this tendency to regional homogeneity as do telephone companies' procurement policies tending to favour suppliers of proven reliability.

Yet Canada's geographic extent does, in some ways, strengthen the market for communications equipment. Because of this country's size and the many geographic barriers dividing the population, Canadians and their governments have attached considerable priority to the creation of an efficient communications system. Certainly, domestic communications equipment manufacturers have benefited from Canada's possession of one of the most extended and intensive communications systems in the world.

The relative sophistication of the Canadian communications system has meant that communications equipment manufacturers must continually try to keep abreast of technological change. New product lines and even new companies have emerged to exploit the many opportunities arising from the recent convergence of computer and telecommunications technologies, with the result that competition among communications equipment manufacturers is even more intense. But the Canadian market alone with its relatively small size and the structural constraints it imposes on manufacturers, may not be sufficient to sustain all these new and innovative entrepreneurs.

THE FOREIGN SALES IMPERATIVE

Confronted by the limits of the Canadian market and pressed by the need to devote more resources to R&D in an industrial environment where the pace of technological evolution is relentlessly quickening, the Canadian communications equipment manufacturers are seeking opportunities in foreign lands to secure the larger sales bases they require to remain viable and competitive in the home and foreign markets. The convergence of computer and telecommunications

technologies intensifies the process by eroding the traditional distinctions between markets for different product lines.

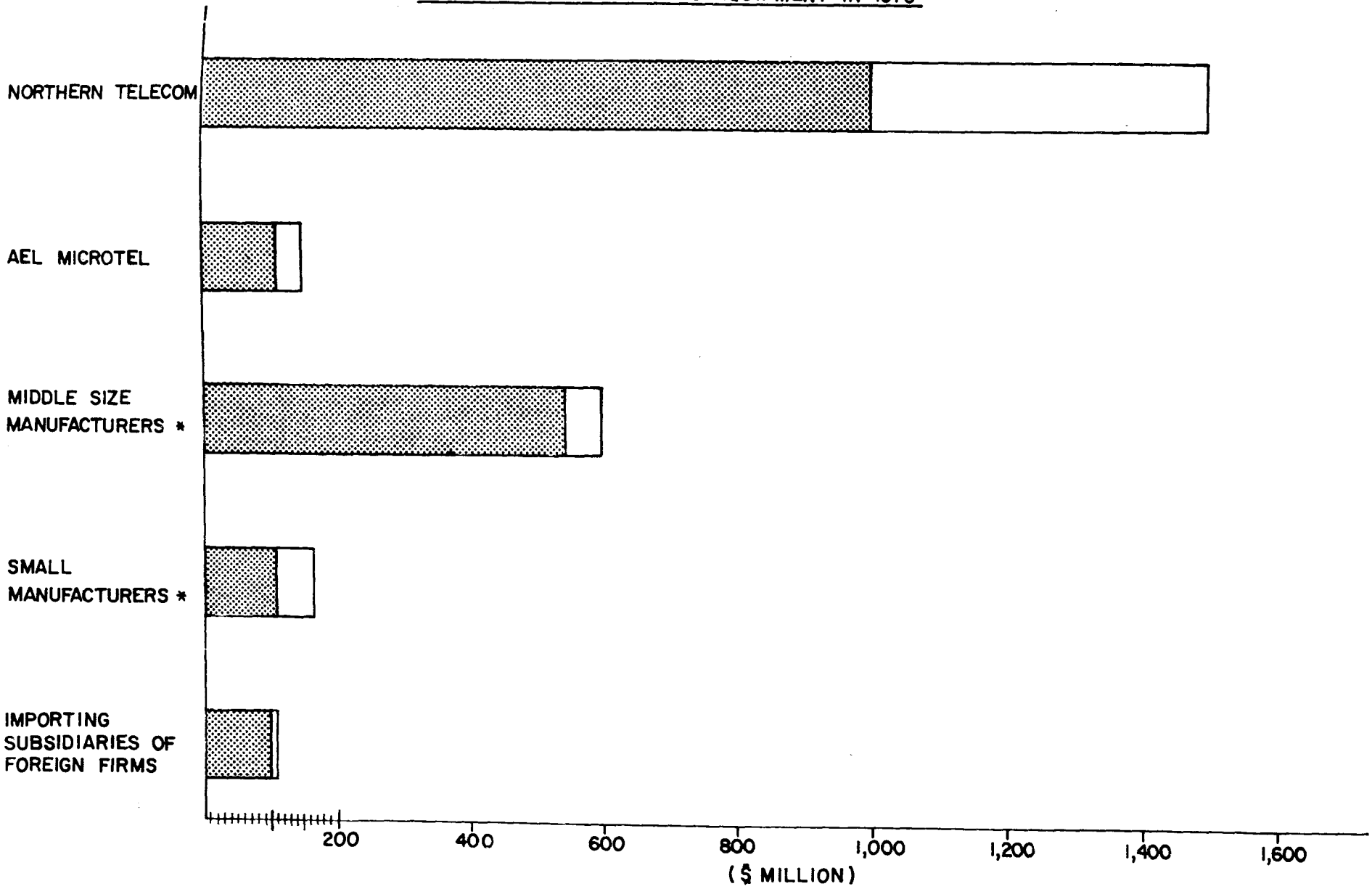
Most Canadian exporters are competitive on the world scene because their marketing skills and R and D work have been of sufficient quality to give them a comparative advantage. They differ profoundly, however, in the size of their foreign sales and the types of foreign markets they penetrate.

As can be seen in Figure 8-1, Northern Telecom has by far the largest foreign sales volume. Its success derives from the fact that it is a large company offering comprehensive state-of-the-art product lines and servicing them from readily accessible locations (Chapter 2). This ability to produce, deliver and service complete communications systems is especially important in selling to developing countries that lack the facilities to produce their own communications equipment. This sector of the world market is most attractive because such countries generally make large initial orders and require considerable follow-up assistance in order to maintain an operating system.

Other Canadian telecommunications equipment manufacturers have also been successful in foreign markets. AEL Microtel had the second largest foreign sales volume in 1978. Manufacturers earning between $10 million and $100 million a year and manufacturers earning less than $10 million a year had, as groups, larger foreign sales volumes than AEL Microtel (Figure 8-1). These smaller manufacturers generally compete for markets in industrialized countries where sophisticated communications plants are already in place. As Chapter 4

FIGURE 8-1

SALES OF COMMUNICATIONS EQUIPMENT IN 1978



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revealed, they usually sell low-volume and/or special-purpose products of lesser interest to the larger manufacturers.

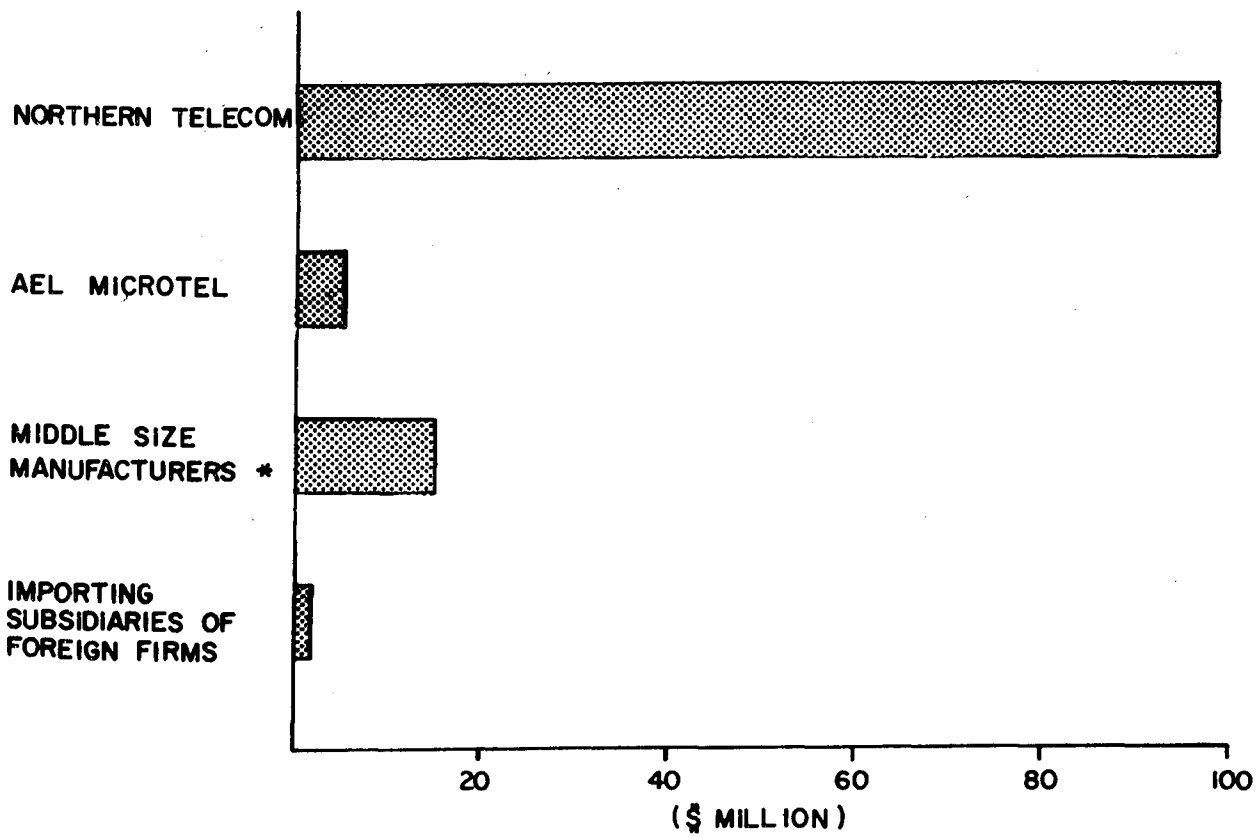
Canadian manufacturers who seek foreign markets are generally among the most technologically advanced and tend to spend the most on R and D. As can be seen in Figure 8-2, Northern Telecom is by far the biggest spender on R and D. AEL Microtel also allocates ever increasing resources to that end. But the leaders are not alone in such endeavours; as Chapter 4 indicated, many middle-sized firms incur significant R and D expenditures and spend, as a group, roughly three times as much on R and D as AEL Microtel (Figure 8-2).

The movement of Canadian communications equipment manufacturers into foreign markets is a welcome development for reasons other than trade considerations. Once a company has become competitive on the world scene, it must continue to invest heavily in R and D to maintain and bolster its comparative advantage. Often such a company becomes a technological leader as it aggressively strives to enlarge its share of the world market. The Canadian communications system benefits from this technological leadership because Canadian carriers and other providers of communications services are able to purchase from Canadian sources the very latest in internationally competitive equipment.

In short, the successful pursuit of foreign opportunities by Canadian communications equipment manufacturers is vital to Canada's future in communications. Without it, Canadian providers of communications services would either have to go abroad for the latest equipment or settle for less than

FIGURE 8-2

EXPENDITURES ON R & D IN CANADA
BY MANUFACTURERS / SUPPLIERS OF
COMMUNICATIONS EQUIPMENT IN 1978



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the best from domestic manufacturers. Canadian companies able to compete in foreign markets are also better able to shield indigenous manufacturing activities from foreign assaults in the domestic market.

BARRIERS TO FOREIGN SALES

The recent success of Canadian communications equipment manufacturers in foreign markets should not blind Canadians to the difficulties our exporters encounter in a world market characterized by intense competition and preferential treatment of "native sons" by governments.

As Chapter 7 pointed out, Northern Telecom is the smallest multinational communications equipment manufacturers in the billion dollar club. All members of this group rely just as heavily as Northern Telecom on technological leadership, comprehensiveness of product lines and economies of scale to win a dominant position in world markets. In addition, there are several smaller foreign manufacturers which provide specialized and/or low-volume products in competition with Canadian exporters in these markets.

There is a tendency for people to assume that competition is only fair and to be expected on the world scene. They see that, as a trading nation, Canada earns a proportion of its national income from sales in foreign markets and, in return, purchases abroad. They perceive international trade as beneficial, not only as a means of getting goods unavailable at home, but also as a stimulus to competition in the domestic market. They readily accept imports as substitutes for domestically produced goods which cannot compete in

terms of price and/or quality. They also tend to assume that a similar attitude prevails abroad.

Such an idyllic competitive situation does not always exist. Certain governments tend to favour domestically produced goods over foreign goods as long as the former can meet certain basic requirements. Considerations such as insuring diversity of supply or promoting the competitiveness of the domestic industry are secondary in such instances. Such preferential treatment is usually a matter of trade strategy. The countries involved promote, to the greatest extent possible, the sale of domestically manufactured goods and limit their imports to raw or semi-processed materials. Tariffs are seldom the principal means of achieving such objectives; non-tariff barriers are used extensively for such purposes. These barriers have definitely limited the foreign sales of communications equipment manufacturers. Although Canadian firms have consistently demonstrated high standards of technological competence and service quality, they have encountered difficulties translating their comparative advantage into the trade benefit that might have been expected.

Canadian telecommunications equipment manufacturers have, however, been able to enter the markets of countries lacking an indigenous communications equipment manufacturing capability. They have also successfully penetrated the relatively open American market, even though the United States has the largest communications equipment manufacturing industry in the world. But they have been unable to make inroads into the markets of certain countries with a domestic production industry, even when the competitive edge of the Canadian

products is unchallenged. The reason for this failure is generally the presence of non- tariff barriers to foreign-made communications equipment.

As long as these barriers persist, Canada cannot ignore them. We must take them into account in the formulation of our trade policy and develop a position that recognizes the different attitudes and behaviours of our trading partners in communications equipment matters.

THE SIGNIFICANCE OF TELECOMMUNICATIONS REGULATIONS

Though public agencies and corporations provide a significant proportion of Canada's communications services, nearly 80 per cent of all Canadians are served directly by private sector firms. Because of the nature of communications, the industry is qualified as a natural monopoly which must be regulated to assert the public interest. This kind of regulation can have a significant impact on communications equipment manufacturers.

A discernible trend now exists in government towards less regulation and the encouragement of more competition as a stimulus to innovation. Some observers argue that communications technology is advancing so rapidly that only competition between providers of communications equipment in meeting customers' preferences can satisfy public demand for efficient modern services. They claim that vertical integration in the communications industry does not encourage utilization of new technologies which may improve service and reduce costs. They also contend that, even when there is no alternative to employing new

technologies, the approach of communications monopolies is characterized by overcautious gradualism.

It will not be sufficient if, when these issues are resolved, the public interest is defined only in terms of possible benefits to customers from lower prices and quantity and quality of new services. The public interest will also be affected by the implications of these decisions for communications equipment manufacturers which currently employ more than 40,000 Canadians. The lasting health of these manufacturers could be at stake, and it would run counter to the public interest if a decision on competition within the communications industry permitted serious inroads by foreign suppliers into the Canadian communications equipment market without providing Canadian manufacturers with compensatory opportunities in foreign markets. Even the United States, with the largest and most open communications equipment market in the world, recognizes this fundamental imperative. Government agencies require significant American value-added in most equipment used in the U.S. domestic communications systems.

THE CARRIER CONNECTION

In many high technology endeavours involving large capital outlays, special relationships develop over time between suppliers and buyers, ranging from preferential procurement policies to various kinds of corporate association. The Canadian communications industry is no exception to this rule. Such relationships are deemed essential by manufacturers with comprehensive product lines as they provide the market bases needed to recover necessarily

high R and D costs and to introduce and test new products. Such relationships also are deemed essential by large carriers to assure continuity of supply and adequate support services. Both sides are said to receive substantial benefits from these associations in terms of better scheduled production, lower inventory and exchanges of information on new technologies.

These arrangements encounter some criticism. As noted before, some observers, pointing to rapid technological change and the ever more diversified competitive state of telecommunications manufacturing, argue that only arm's length relationships can assure fair prices to customers for communications services. They conclude that only the absence of intercorporate relationships coupled with open competitive bidding can improve the present situation.

Conversely, others insist that these arguments should take account of the realities of the world telecommunications equipment market, pointing out that special links between major carriers and equipment manufacturers are the rule rather than the exception in all major industrialized countries. They remind us that, even in the United States, where there has been a shift in the last two decades towards weakening intercorporate association and intensifying competition in the communications industry, intercorporate relationships continue to exist in part because of the overriding need to protect the interests of a major American industry and its employees.

And while the United States experience is an object lesson in this regard, it also carries another message of interest for Canada and Canadian manufacturers. There is little doubt that the opening of the American market

created interesting opportunities for foreign manufacturers and that Canadians were quick to take advantage of the situation. However, it also induced manufacturers from Europe and Japan to come and establish subsidiaries in the United States to compete with American and Canadian manufacturers. These subsidiaries are manufacturing to North-American standards and, in so doing, have eliminated one of the long standing obstacles to their parents' penetration of the North-American market i.e. the fact that the parents' products were not selling because they were not tailored to North-American standards and that they could not be produced to North- American standards because the parents had not acquired a sufficient share of the North-American market. This quandary having been removed by the opening of the American market, the communications equipment manufacturing capacity of the United States has been augmented by the arrival of off-shore multinationals which are now ready to enter the Canadian market with North-American designed products if such a course of action becomes attractive as a result of directed changes in manufacturers/ carriers relationships in Canada.

Arguments against intercorporate relationships must also be tempered by a fuller appreciation of the profound implications of the global economic difficulties of recent years. More than ever, businesses are attaching priority to husbanding resources, building on existing sources of strength, branching out from secure areas of activity and optimizing economies of scope and scale. Such a cautious approach reflects the austere realities of the 1980s.

While the dismantling of special relationships between certain Canadian carriers and communications equipment manufacturers could have serious adverse

effects, the maintenance of such links should not deny the competitive aspirations of small autonomous manufacturers. As noted in Chapters 4 and 5, many such manufacturers have emerged or expanded in recent years and deserve encouragement. In the final analysis, the interests of these small manufacturers may not diverge that much from those of the large vertically integrated communications manufacturers and their associated carriers. Small manufacturers often provide products which complement those of large manufacturers while the presence of large domestic manufacturers in the home market can discourage massive assaults by foreign multinationals, thus indirectly protecting small domestic manufacturers. Yet vertically integrated and autonomous manufacturers' interests sometime conflict. Such differences can and must be reconciled in a spirit of constructive compromise, taking into account not only the long term interests of consumers and producers of communications equipment but also those of the nation as well.

OWNERSHIP OF COMMUNICATIONS EQUIPMENT MANUFACTURING FIRMS OPERATING IN CANADA